

AEROSPACE MEDICINE AND BIOLOGY

**A CONTINUING BIBLIOGRAPHY
WITH INDEXES**

(Supplement 330)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in November 1989 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*.



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INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 156 reports, articles and other documents announced during November 1989 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of the bibliography was published in July 1964.

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. In general, emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the bibliography consists of a bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes — subject, personal author, corporate source, foreign technology, contract, report number, and accession number — are included.

An annual index will be prepared at the end of the calendar year covering all documents listed in the 1989 Supplements.

Information on the availability of cited publications including addresses of organizations and NTIS price schedules is located at the back of this bibliography.

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TYPICAL REPORT CITATION AND ABSTRACT

NASA SPONSORED
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ACCESSION NUMBER → N89-11384*# Houston Univ., Tex. Dept. of Biology. ← CORPORATE SOURCE
TITLE → GROWTH OF PLANT TISSUE CULTURES IN SIMULATED LUNAR SOIL: IMPLICATIONS FOR A LUNAR BASE CELSS (CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM) Final Report, 1 Feb. 1987 - 31 Jul. 1988
AUTHOR → S. VENKETESWARAN 1988 £5 p
(Contract NAG9-214)
REPORT NUMBERS → (NASA-CR-183233; NAS 1.26:183233) Avail: NTIS HC A04/MF
A01 CSCL 06C
COSATI CODE → Experiments were carried out on plant tissue cultures, seed germination, seedling development and plants grown on Simulated Lunar Soil to evaluate the potential of future development of lunar based agriculture. The studies done to determine the effect of the placement of SLS on tissue cultures showed no adverse effect of SLS on tissue cultures. Although statistically insignificant, SLS in suspension showed a comparatively higher growth rate. Observations indicate the SLS, itself cannot support calli growth but was able to show a positive effect on growth rate of calli when supplemented with MS salts. This positive effect related to nutritive value of the SLS was found to have improved at high pH levels, than at the recommended low pH levels for standard media. Results from seed germination indicated that there is neither inhibitory, toxicity nor stimulatory effect of SLS, even though SLS contains high amounts of aluminum compounds compared to earth soil. Analysis of seedling development and growth data showed significant reduction in growth rate indicating that, SLS was a poor growth medium for plant life. This was confirmed by the studies done with embryos and direct plant growth on SLS. Further observations attributed this poor quality of SLS is due to it's lack of essential mineral elements needed for plant growth. By changing the pH of the soil, to more basic conditions, the quality of SLS for plant growth could be improved up to a significant level. Also it was found that the quality of SLS could be improved by almost twice, by external supply of major mineral elements, directly to SLS.
Author

PUBLICATION DATE
PRICE CODE
AVAILABILITY SOURCE

TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

NASA SPONSORED

ACCESSION NUMBER → A89-11286* Maryland Univ., Baltimore.
TITLE → PROGRAMMED ENVIRONMENT MANAGEMENT OF CONFINED MICROSOCIETIES
AUTHOR → HENRY H. EMURIAN (Maryland, University, Baltimore) ← AUTHOR'S AFFILIATION
JOURNAL TITLE → Space, and Environmental Medicine (ISSN 0095-6562), vol. 59,
PUBLICATION DATE → Oct. 1988, p. 976-980. refs
(Contract NGR-21-001-111; N00014-80-C-0467)

A programmed environment is described that assists the implementation and management of schedules governing access to all resources and information potentially available to members of a confined microsociey. Living and work schedules are presented that were designed to build individual and group performance repertoires in support of study objectives and sustained adaptation by participants. A variety of measurement requirements can be programmed and standardized to assure continuous assessment of the status and health of a confined microsociey.
Author

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 330)

DECEMBER 1989

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LIFE SCIENCES (GENERAL)

A89-48296* Wright State Univ., Dayton, OH.
**BLOCKADE OF 5-HYDROXYTRYPTAMINE(3) RECEPTORS
PREVENTS CISPLATIN-INDUCED BUT NOT MOTION- OR
XYLAZINE-INDUCED EMESIS IN THE CAT**

JAMES B. LUCOT (Wright State University, Dayton, OH)
Pharmacology, Biochemistry and Behavior (ISSN 0091-3057), vol. 32, 1989, p. 207-210. Research supported by A. H. Robins Co. refs

(Contract NCC2-220)

The effects of the 5-hydroxytryptamine(3) (5-HT-3) antagonists ICS 205-930 and MDL 72222 on the emesis induced by motion or by emetic doses of xylazine (0.66 mg/kg administered SC) or cisplatin (7.5 mg/kg infused over a period of 4-5 min) were investigated in cats. It was found that neither the low (0.1 mg/kg) or the high (1.0 mg/kg) doses of ICS 205-930 or MDL 72222 prevented emesis elicited by screening motion challenges or xylazine. On the other hand, treatment cats by 1.0 mg/kg of ICS 205-930 was effective against cisplatin-induced motion sickness, in agreement with earlier results obtained on other mammals.

I.S.

A89-48710

**RESEARCH ON BIOLAB, A MULTI-USER FACILITY FOR APM
MARIANIE COGOLI and AUGUSTO COGOLI (Zuerich,
Eidgenoessische Technische Hochschule, Zurich, Switzerland)
(ESA, Ministry for Science and Technology of Italy, and BMFT,
Columbus Symposium, 4th, Friedrichshafen, Federal Republic of
Germany, Sept. 12-15, 1988) Space Technology - Industrial and
Commercial Applications (ISSN 0892-9270), vol. 9, no. 1-2, 1989,
p. 41-45. refs**

(Contract ESA-7695/88/F/FL)

The results of a study on the design of the Biolab biological laboratory for Columbus APM are discussed. The major scientific and technological objectives of the facility are identified, and the essential equipment to achieve these objectives is described. The accommodation of these instruments within the racks available is addressed, and the crew involvement in Biolab operation is discussed.

C.D.

A89-48711

**HUMAN PHYSIOLOGY LABORATORY ON COLUMBUS
FLEMMING BONDE-PETERSEN (National Hospital, Copenhagen,
Denmark) (ESA, Ministry for Science and Technology of Italy,
and BMFT, Columbus Symposium, 4th, Friedrichshafen, Federal
Republic of Germany, Sept. 12-15, 1988) Space Technology -
Industrial and Commercial Applications (ISSN 0892-9270), vol. 9,
no. 1-2, 1989, p. 47-50.**

The scientific objectives of the human physiology laboratory on Columbus are outlined, and the functional requirements for attaining those objectives are discussed. These include the further development of the Anthracrack core elements, service elements, and experiment-specific elements. The topics to be studied in

animal physiology are outlined and a large variable centrifuge for this purpose is described. The Columbus Mission Implementation Organization is discussed. C.D.

A89-50736

SPACE - A TESTBED FOR BASIC BIOMEDICAL SCIENCES

D. GRUNDY and T. SCRATCHERD (Sheffield, University, England) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Aug. 1989, p. 349-351. refs

In Space many bodily functions adjust to absence of gravity. The understanding of these homeostatic processes have depended on studies on man and other animals. The present paper briefly reviews how such studies may benefit some terrestrial medical problems.

Author

A89-50737

BIOPHYSICS IN SPACE

P. A. HANSSON (Commercial Space Technologies, Ltd., London; Sheffield, University, England) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Aug. 1989, p. 352-356. refs

The biological effects of space are discussed in the framework of biophysics. The general effects of microgravity are outlined. The effects of free radicals and radiation are examined. Consideration is given to cells in space and protein crystallography. The advantages of using biophysics to study the effects of space are emphasized.

R.B.

A89-50925

**COMPARISON OF THE EFFECTS OF THYROLIBERIN AND
ACTH(4-7) PGP ON THE LEARNING CAPACITY OF RATS
PERFORMING SPACE ORIENTATION TASKS [SRAVNENIE
VLIANII TIROLIBERINA I AKTG/4-7/ PGP NA OBUCHENIE
KRYIS PRI RESHENII ZADACH NA PROSTRANSTVENNIUI
ORIENTATSIUI]**

N. E. CHEPURNOVA, A. A. GUSEVA, E. V. EFIMOVA, A. A. MART'IANOV, and S. A. CHEPURNOV (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) Fiziologicheskii Zhurnal SSSR (ISSN 0015-329X), vol. 75, May 1989, p. 677-683. In Russian. refs

The effects of thyroliberin (TRH) and ACTH(4-7) PGP on the spatial memory of rats were investigated using rats injected daily with 100 microg/kg of TRH (100 microg/kg) and/or 50 microg/kg ACTH(4-7) PGP prior to subjecting these animals to space orientation tasks in a 12-arm radial maze or a T-maze, in which one of the maze sections contained a vessel with food, while other sections had empty vessels. It was found that both peptides decreased the number of errors (i.e., number of visits to empty food vessels) made by experimental rats, as compared with controls. The effects of the TRH and ACTH did not interfere with one another.

I.S.

A89-51513

**THE BIOENERGETICS OF ANAEROBIC BACTERIA -
EVOLUTIONARY CONCEPTS**

K. DOSE (Mainz, Universitaet, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 93-100. refs

51 LIFE SCIENCES (GENERAL)

Steps that are likely to have been part of the energy-metabolism evolution in anaerobic bacteria are proposed. It is suggested that the first stages in the development of membrane-bound phosphorylation systems included the substrate-level phosphorylation; the coupling of membrane-bound decarboxylation to ATP synthesis; the coupling of the membrane-bound ATP synthesis to electron transfer reactions that involved the use of ubiquitous electron acceptors like $\text{Fe}(3+)$, sulfate, or CO_2 ; and, finally, the evolution of phosphosynthetic CO_2 reduction. I.S.

A89-51514

MICROBIOLOGY AND BIOCHEMISTRY OF THE METHANOGENIC ARCHAEOBACTERIA

DARREN R. ABBANAT, DAVID J. ACETI, STEPHEN F. BARON, KATHERINE C. TERLESKY, and JAMES G. FERRY (Virginia Polytechnic Institute and State University, Blacksburg) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 101-105. Research supported by the Gas Research Institute. refs

(Contract NSF DMB-84-09558)

Differences between the microstructure and biochemistry of the methanogenic archaeobacteria and those of other procaryotes (eubacteria) and eucaryotes are discussed. The distinctions include the unique structures of cell-wall and membrane components present in archaeobacteria, as well as the differences in the highly conserved 16S rRNA sequences among the three kingdoms. The methanogens exhibit two pathways of methane formation. One is the reduction of CO_2 with H_2 or formate, which involves cofactors such as methanofuran, tetrahydromethanopterin, and coenzyme M, which function as one-carbon carriers during the CO_2 reduction. The other pathway is the conversion of acetate to methane and carbon dioxide; this pathway involves an activation of acetate to acetyl-S-CoA followed by decarbonylation and reduction of the methyl group to methane coupled to the oxidation of the carbonyl group to CO_2 . I.S.

A89-51515

METHANOGENS - SYNTROPHIC DEPENDENCE ON FERMENTATIVE AND ACETOGENIC BACTERIA IN DIFFERENT ECOSYSTEMS

J. WINTER and G. KNOLL (Regensburg, Universitaet, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 107-116. refs

This paper discusses the dependence of methanogenic bacteria on fermentative and acetogenic bacteria, and of acetogenic bacteria on the methanogens, to maintain a low hydrogen partial pressure by interspecies hydrogen transfer. The scheme of the carbon flow during the degradation of different carbon sources is examined. Special attention is given to the pathways of anaerobic degradation of synthetic chemicals such as OH-benzoate or phenol by microbial cultures containing a *Methanospirillum* organism. I.S.

A89-51516

FUNCTION AND THE BIOSYNTHESIS OF UNUSUAL CORRINOIDS BY A NOVEL ACTIVATION MECHANISM OF AROMATIC COMPOUNDS IN ANAEROBIC BACTERIA

E. STUPPERICH and H. J. EISINGER (Ulm, Universitaet, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 117-125. Research supported by the Universitaet Ulm. refs

Several newly described anaerobic bacteria were screened for the type of their corrinoids, and the biosynthetic pathways for some of the unusual corrinoids were investigated along with their

functions. A novel stereospecific activation mechanism was detected in the culture of *Sporomusa ovata*, that is responsible for the synthesis of a unique paracresolyl cobamide, detected in both the membrane and the cytosol fractions from cells of this organism. It is suggested that the transfer of a methyl radical is one of the probable functions of the paracresolyl cobamide in *Sporomusa*. I.S.

N89-27327# Rome Univ. (Italy). Dipartimento di Fisica. CATEGORIZATION IN NEURAL NETWORKS AND PROSOPAGNOSIA

M. A. VIRASORO 28 Jun. 1988 11 p Submitted for publication (PREPRINT-608; ETN-89-94696) Avail: NTIS HC A03/MF A01

It is argued that prosopagnosia, a syndrome characterized by a generalized difficulty to visually recognize individual patterns among those that are similar to it and that therefore can be said to belong to the same category, may be an important clue for understanding the categorization process in the brain. In this direction neural network performance under random destruction of synapses is analyzed. It is found that in almost every network that stores correlated patterns, the coding of the discriminating details between individuals inside a class is more sensitive to noise or to random destruction than the coding that distinguishes classes. It follows that a process of death and/or deterioration at an intermediate level of intensity, even if it acts randomly on the network may lead to a malfunctioning of the network that resembles prosopagnosia. ESA

N89-27328# Rome Univ. (Italy). Dipartimento di Fisica. THE EFFECT OF SYNAPSES DESTRUCTION ON CATEGORIZATION BY NEURAL NETWORKS

M. A. VIRASORO 28 Jun. 1988 10 p Submitted for publication (PREPRINT-609; ETN-89-94697) Avail: NTIS HC A02/MF A01

The probability measure on neural network interactions introduced by Gardner (1988) is used to analyze the effect of a random destruction of synapses in a network that stores ultrametric patterns. At an intermediate level of destruction the retrieval of the pattern is impaired particularly in those items that permit the distinction among exemplars in a class. ESA

N89-27329# Chicago Univ., IL. Dept. of Medicine. DEVELOPMENT OF ADVANCED METHODS BASED ON STABLE ISOTOPE TECHNOLOGY FOR STUDIES OF EXERCISE IN HEAT Report, 28 Sep. 1987 - 31 Mar. 1989 MORTEZA JANGHORANI 15 Apr. 1989 19 p (Contract DAMD17-87-C-7235; DA PROJ. 3M1-61102-AS-15) (AD-A208758) Avail: NTIS HC A03/MF A01 CSCL 06/10

Stable isotope methods were developed for precise and accurate measurement of isotopes of bromine, magnesium, and potassium in tissues. The methods were applied to the measurement of extracellular fluid volume using the swine model, and to exchangeable pool sizes of magnesium and potassium using the rat model. It was shown that the bromine method could be combined with the stable isotope methodology for the measurement of total body water to investigate body water compartments. It was shown that the bromine method could be used to investigate changes in exchangeable body magnesium in the rat by dietary manipulation. GRA

N89-28198# California Univ., Santa Barbara. Marine Science Inst.

MOLECULAR BIOLOGY OF THE PHOTOREGULATION OF PHOTOSYNTHETIC LIGHT-HARVESTING COMPLEXES IN MARINE DINOFLAGELLATES Annual Report, 15 Jun. 1988 - 15 Jun. 1989

BARBARA B. PREZELIN and EDWARD L. TRIPLETT 2 Jun. 1989 14 p (Contract N00014-88-K-0003) (AD-A205650) Avail: NTIS HC A03/MF A01 CSCL 06/3

The goal is to continue to use biotechnological techniques to study the genetic bases of light- and nutrient-regulation of

photosynthetic light-harvesting complexes in marine dinoflagellates and their consequences for the bio-optical features of these algae. The studies are significant to determining the molecular bases of environmental regulation of gene expression and photosynthetic performance in marine phytoplankton. Results also contribute to understanding the linkages between light environments and cell optical properties, key elements in physiologically-based bio-optical models being developed to predict ocean primary production.

GRA

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

A89-48085

DIAGNOSTIC POTENTIAL OF THE EKG MONITORING OF FLIGHT PERSONNEL UNDER FLIGHT CONDITIONS
[DIAGNOSTICHESKIE VOZMOZHNOСТИ METODA EKG-MONITORIROVANIYA U LETNOGO SOSTAVA V USLOVIYAKH POLETA]

V. M. KONDRAKOV and V. I. SINOPAL'NIKOV Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), May 1989, p. 57-59. In Russian. refs

The value of the EKG monitoring of flight personnel engaged in flight maneuvers for the detection of asymptomatic disorders of myocardial functions and coronary circulation was investigated in 22 pilots. Subjects fitted with portable cardiomonitors performed 65 flights on a one-seat aircraft, with four of these flights being low-altitude flights, and 16 including maneuvers with acceleration loads reaching 3.5 to 4 G. Fifteen of the subjects were found to display abnormalities in the heart rhythm, including 13 with supraventricular disturbances and two with ventricular extrasystole. In nine of these subjects, the EKG abnormalities could be detected in flights which did not involve extraordinary emotional loads.

I.S.

A89-48173*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

HUMAN TOLERANCE TO SPACE FLIGHT

C. L. HUNTOON (NASA, Johnson Space Center, Houston, TX) AIAA and NASA, Symposium on the Maintainability of Aerospace Systems, Anaheim, CA, July 26, 27, 1989. 9 p. refs (AIAA PAPER 89-5062)

Medical studies of astronauts and cosmonauts before, during, and after space missions have identified several effects of weightlessness and other factors that influence the ability of humans to tolerate space flight. Weightlessness effects include space motion sickness, cardiovascular abnormalities, reduction in immune system function, loss of red blood cells, of bone mass, and muscle atrophy. Extravehicular activity (EVA) increases the likelihood that decompression sickness may occur. Radiation also gives reason for concern about health of crewmembers, and psychological factors are important on long-term flights. Countermeasures that have been used include sensory preadaptation, prebreathing and use of various air mixtures for EVA, loading with water and electrolytes, exercise, use of pharmacological agents and special diets, and psychological support. It appears that humans can tolerate and recover satisfactorily from at least one year of space flight, but a number of conditions must be further ameliorated before long-duration missions can be considered routine.

Author

A89-48285

CALORIC VESTIBULAR TESTS IN WEIGHTLESSNESS [LES EPREUVES VESTIBULAIRES CALORIQUES EN IMPESANTEUR]

CLAUDE-ALEXANDRE TIMSIT (Medispace, Paris, France) Encyclopedie Medico-Chirurgicale, no. 2, 1987, 4 p. In French. refs

The detection aboard Spacelab flights in November 1983 and October 1985 of a caloric nystagmus with the same characteristics of that found on the ground before and after the mission suggests that this phenomenon may not be due to thermal convection. It is proposed that the most significant factor in this phenomenon may be the variation of endolymphatic volume in the horizontal semicircular canal, a variation that is associated with the induced temperature gradient. Application of this temperature gradient in an asymmetric fashion would provoke a volume displacement and, thus, a pressure variation on the two faces of the cupula. The present scenario is consistent with in-flight data. It is suggested that this process also occurs on earth, but is masked by convective phenomena.

R.R.

A89-48286

ROLE OF THE OTORHINOLARYNGOLOGIST IN THE SELECTION AND TRAINING OF ASTRONAUTS [ROLE DE L'OTO-RHINO-LARYNGOLOGISTE DANS LA SELECTION ET L'ENTRAINEMENT DES ASTRONAUTES]

CLAUDE-ALEXANDRE TIMSIT (Medispace, Paris, France) Encyclopedie Medico-Chirurgicale, no. 2, 1987, 4 p. In French. refs

The roles of the otorhinolaryngologist in selecting candidates for space flight whose vestibular systems are capable of supporting the stress of the rigorous preflight training, and in the training process itself, are considered. The otorhinolaryngological examination includes audiological testing, vestibular testing (including electronystagmography, tests of the response of the vestibular system to Coriolis and rotational acceleration, and Voatchek otolith reaction tests), and oculomotor testing. Otorhinolaryngological training methods include spatial disorientation simulations, optokinetic stimulation tests, oscillating platforms, biofeedback, and parabolic flight tests along Keplerian trajectories.

R.R.

A89-48294* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

IMPROVED READING PERFORMANCE USING INDIVIDUALIZED COMPENSATION FILTERS FOR OBSERVERS WITH LOSSES IN CENTRAL VISION

TERI B. LAWTON (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) Ophthalmology (ISSN 0161-6420), vol. 96, Jan. 1989, p. 115-126. refs

A method to improve the reading performance of subjects with losses in central vision is proposed in which the amplitudes of the intermediate spatial frequencies are boosted relative to the lower spatial frequencies. In the method, words are filtered using an image enhancement function which is based on a subject's losses in visual function relative to a normal subject. It was found that 30-70 percent less magnification was necessary, and that reading rates were improved 2-3 times, using the method. The individualized compensation filters improved the clarity and visibility of words. The shape of the enhancement function was shown to be important in determining the optimum compensation filter for improving reading performance.

R.R.

A89-48383*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

SUMMARY OF PROCEEDINGS OF THE FIRST MEETING OF THE NASA AMES SIMULATOR SICKNESS STEERING COMMITTEE

LAWRENCE J. HETTINGER, MICHAEL E. MCCAULEY (Monterey Technologies, Inc., Carmel, CA), ANTHONY E. COOK (NASA, Ames Research Center, Moffett Field, CA), and JAMES W. VOORHEES (U.S. Army, Aeroflightdynamics Directorate, Moffett Field, CA) IN: AIAA Flight Simulation Technologies Conference and Exhibit, Boston, MA, Aug. 14-16, 1989, Technical Papers Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 50-61. refs (AIAA PAPER 89-3268)

A program of research to investigate simulator induced sickness has recently been initiated under the sponsorship of NASA Ames Research Center to coordinate efforts to investigate and eventually eliminate the problem of simulator sickness. As part of this program, a Simulator Sickness Steering Committee has been assembled, comprised of eighteen representatives from the Army, Air Force, Navy, NASA, NATO, academia, and industry. The proceedings of the first meeting of the NASA Ames Simulator Sickness Steering Committee are summarized and discussed. Author

A89-48384#**SIMULATOR SICKNESS ON THE INCREASE**

R. S. KENNEDY (Essex Corp., Orlando, FL), G. O. ALLGOOD (Martin Marietta Energy Systems, Inc., Oak Ridge, TN), and M. G. LILIENTHAL (U.S. Navy, Naval Training Systems Center, Orlando, FL) IN: AIAA Flight Simulation Technologies Conference and Exhibit, Boston, MA, Aug. 14-16, 1989, Technical Papers, Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 62-67. refs

(AIAA PAPER 89-3269)

The usefulness of innovations in simulation technology may be compromised by a poorly understood phenomenon, viz, simulator sickness. Simulator sickness refers to motion sickness-like symptoms that occur in aircrew during and following training. This paper (1) describes and summarizes the implications of simulator sickness, and (2) discusses a biocybernetic approach to the control of the problem. Author

A89-48817* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, CA.

ADJUSTMENT OF SLEEP AND THE CIRCADIAN TEMPERATURE RHYTHM AFTER FLIGHTS ACROSS NINE TIME ZONES

PHILIPPA H. GANDER, GRETE MYHRE, R. CURTIS GRAEBER, JOHN K. LAUBER (NASA, Ames Research Center, Moffett Field, CA), and HARALD T. ANDERSEN (Royal Norwegian Air Force, Institute of Aviation Medicine, Oslo, Norway) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Aug. 1989, p. 733-743. refs

The adjustment of sleep-wake patterns and the circadian temperature rhythm was monitored in nine Royal Norwegian Airforce volunteers operating P-3 aircraft during a westward training deployment across nine time zones. Subjects recorded all sleep and nap times, rated nightly sleep quality, and completed personality inventories. Rectal temperature, heart rate, and wrist activity were continuously monitored. Adjustment was slower after the return eastward flight than after the outbound westward flight. The eastward flight produced slower readjustment of sleep timing to local time and greater interindividual variability in the patterns of adjustment of sleep and temperature. One subject apparently exhibited resynchronization by partition, with the temperature rhythm undergoing the reciprocal 15-h delay. In contrast, average heart rates during sleep were significantly elevated only after westward flight. Interindividual differences in adjustment of the temperature rhythm were correlated with some of the personality measures. Larger phase delays in the overall temperature waveform (as measured on the 5th day after westward flight) were exhibited by extraverts, and less consistently by evening types. Author

A89-48819**REDUCTION OF VISUALLY-INDUCED MOTION SICKNESS ELICITED BY CHANGES IN ILLUMINATION WAVELENGTH**

THOMAS G. DOBIE, JAMES G. MAY, WILLIAM P. DUNLAP, and MICHAEL E. ANDERSON (New Orleans, University; Tulane University, LA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Aug. 1989, p. 749-754. refs

This experiment was undertaken to assess the degree of stimulus generalization in visually-induced motion sickness. Sixteen subjects participated in six sessions in which they were exposed to a rotating field of vertical stripes for five 4-min trials. This stimulus elicited the perception of self-vection in the first three sessions, the stripes were illuminated by one monochromatic light (red or green) and in the last three sessions, the stripes were illuminated

by the other monochromatic light. Magnitude estimates of motion sickness increased significantly within sessions, but the rate at which this measure increased was significantly diminished across trials in the last three-session block. Magnitude estimates of vection increased within sessions and decreased across sessions, but did not increase with color change. These results can be explained in terms of a model of stimulus generalization and have implications for the reduction of motion sickness in applied settings. Author

A89-48820**VESTIBULAR HABITUATION IN STUDENT PILOTS**

U. SCHWARTZ (NIH, Bethesda, MD) and V. HENN (University Hospital, Zurich, Switzerland) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Aug. 1989, p. 755-761. refs

The dynamics of vestibular nystagmus were measured in 42 military student pilots. Their responses were compared with 40 nonflying subjects of similar age who were also fulfilling requirements for the mandatory Swiss military service. The following differences emerged: the time constant of the nystagmus response after vestibular stimulation was shorter (p less than 0.001; t -test) in student pilots, whereas the gain tended to be higher (p less than 0.025). These changes in the response dynamics are attributed to habituation. Student pilots were additionally tested with conflicting visual-vestibular stimulation. Nystagmus response was delayed and attenuated when compared to stimulation in darkness. Under these conditions motion sickness occurred in one third of the subjects. No relation was found between the occurrence of motion sickness and the value of the time constant or gain of vestibular nystagmus. Results show that there is no single 'normal' value of vestibular nystagmus. This becomes important when defining 'normal' values as opposed to pathological values in vestibular testing. Author

A89-48821**SACCADIC EYE MOVEMENTS IN RESPONSE TO VISUAL, AUDITORY, AND BISENSORY STIMULI**

EDWARD J. ENGELKEN and KENNETH W. STEVENS (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Aug. 1989, p. 762-768. Research supported by USAF. refs

Saccadic eye movements were recorded and analyzed from eight normal human subjects. Various visual, auditory, and bisensory (visual and auditory) targets were tracked. Primary saccade latency, amplitude, duration, and peak velocity were calculated, as well as overall saccade duration (total time spent making saccades) and final eye position. Saccades made to bisensory targets employing a constant-intensity auditory component were not different from the pure visual target responses. Saccades to bisensory targets having an intermittent auditory component (with sound onset synchronous with the visual component) demonstrated a significant reduction in latency (11.3 percent) compared to the visual responses. The reduction occurred both for a fixed overhead sound source and for a sound source moving with the visual component. This result indicates that providing an auditory motion or localization cue alone does not reduce latency, but that a sound onset cue facilitates response time. No other response parameters were enhanced by using bisensory targets. Author

A89-48822**PERFORMANCE AND WELL-BEING UNDER TILTING CONDITIONS - THE EFFECTS OF VISUAL REFERENCE AND ARTIFICIAL HORIZON**

A. ROLNICK (Israeli Naval Hyperbaric Institute, Haifa) and W. BLES (Free University Hospital, Amsterdam, Netherlands) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Aug. 1989, p. 779-785. refs

The possible beneficial effect of a projected artificial horizon on the alleviation of seasickness symptoms in sailors working below deck was investigated. Twelve subjects performing computerized tasks were exposed for 35 min to angular motion in a tilting room under the following conditions: (1) with the windows covered, (2) with the windows uncovered, and (3) with the windows covered

and with a horizon projected on the walls by a rotating laser beam. It was found that the presence of an artificial visual horizon prevented the decrement in performance found in subjects working without such reference in the no-windows condition. I.S.

A89-48823**INCIDENCE OF AIRSICKNESS AMONG MILITARY PARACHUTISTS**

MELCHOR J. ANTUNANO (Wright State University, Dayton, OH) and JOSE M. HERNANDEZ (Fuerza Aerea Mexicana, Santa Lucia AFB, Mexico) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 60, Aug. 1989, p. 792-797. refs

This study describes the incidence of airsickness among military parachutists and analyzes the factors involved in its occurrence. Each of 45 health male subjects (28 students and 17 advanced parachutists) was studied. Each student participated in five parachute-jump exercises (one daily) and each advanced parachutist participated in one exercise only (proficiency). A questionnaire used for the diagnostic evaluation of motion sickness symptoms was completed by the subjects after each training exercise. A positive diagnosis of airsickness was established for 64 percent of the students on their first jump and for 35 percent of the advanced paratroopers on their proficiency jump. By the fifth jump, only 25 percent of the students experienced airsickness. Airsickness among student and advanced paratroopers occurred during the transport flight. This can be attributed to vestibular stimulation resulting from the aircraft maneuvers and inflight air turbulence. Author

A89-48824**METHODS FOR DESCRIBING AND QUANTIFYING +GZ-INDUCED LOSS OF CONSCIOUSNESS**

JAMES E. WHINNERY (U.S. Navy, Naval Air Development Center, Warminster, PA) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 60, Aug. 1989, p. 798-802. refs

A thorough understanding of +Gz-induced loss of consciousness (G-LOC) is enhanced by defining all psychophysiological phenomena associated with G-LOC. A method of measuring the time course of G-LOC events using video recording is developed. The resulting calculated and experimental data allow an accurate description of acceleration exposure, resulting incapacitation, and myoclonic convulsions. Although acute physiologic recovery is included in this quantitative framework, longer psychophysiological recovery remains to be fully evaluated. As such, the techniques developed are established as an initial step in fulfilling the requirement to completely define G-LOC phenomena. Author

A89-48898**THESE VESTIBULAR PROBLEMS WITHOUT GRAVITY [CES PROBLEMES VESTIBULAIRES SANS GRAVITE]**

C. TIMSIT (Societe Francaise de Medecine Aerospatiale, Paris, France) *Annales d'Oto-Laryngologie et de Chirurgie Cervico-Faciale* (ISSN 0003-438X), vol. 103, 1986, p. 235-243. In French. refs

The physiopathology and treatment of motion sickness in space, occurring both in the space vehicle and during EVA due to sudden movements of the head and the repetition of movements, are considered. Previous space sickness data provide no evidence that the vestibular system is affected by variations in the physicochemical characteristics of the membranous labyrinth liquids. It is suggested that biofeedback methods and tolerance training are preferable to the taking of such medications as promethazine/ephedrine and scopolamine/dexadrine mixtures for treating space motion sickness. Data obtained during Spacelab-1 experiments using a vestibular sled reveal the occurrence of caloric nystagmus during weightlessness. R.R.

A89-49799**MOTION-DEBLURRING IN HUMAN VISION**

M. J. MORGAN and S. BENTON (University College, London, England) *Nature* (ISSN 0028-0836), vol. 340, Aug. 3, 1989, p.

385, 386. Research supported by the Medical Research Council. refs

It has been suggested that there are motion-deblurring mechanisms in human vision specifically to aid the visual system in the analysis of the shape of retinally moving targets. Models of motion deblurring have been influenced by the finding that certain very precise spatial pattern discriminations are unaffected by motion. An example is vernier hyperacuity, in which the observer must detect the direction of offset between two lines with abutting ends. With a stationary stimulus, observers can detect a vernier cue of less than 10 arcsec and acuity is unaffected by retinal-image motion of up to 3 deg/s. This finding is confirmed here, but evidence is also provided against any general deblurring mechanism, showing that another kind of hyperacuity, discrimination of the distance between two parallel lines, is interfered with by motion. It is pointed out that the high level of vernier acuity for moving stimuli can be explained by other means.

A89-49800**THE COLOR CENTRE IN THE CEREBRAL CORTEX OF MAN**

C. J. LUECK (Hammersmith Hospital, University College, London; London Hospital, England), S. ZEKI, P. COPE (University College, London, England), K. J. FRISTON, M. F. DEIBER (Hammersmith Hospital, London, England) et al. *Nature* (ISSN 0028-0836), vol. 340, Aug. 3, 1989, p. 386-389. Research supported by the Wellcome Trust. refs

Positron emission tomography was used to study the color center in the striate cortex of the brains of normal human subjects viewing multicolored and black-and-white displays. The results identify a region of the normal human cerebral cortex specialized for color vision. The only area surrounding the striate cortex consistently showing a significant increase in activity during color but not during gray stimulation was located in the region of the lingual and fusiform gyri. The activity of the color area of the left hemisphere was greater than that of the right, regardless of whether the subject was left-handed. There was no substantial change in activity in the temporal cortex, which suggests that the color area is sufficient for the determination of color when there is no involvement of memory or experience. C.D.

A89-50738**PHYSIOLOGICAL PROBLEMS FOR MAN IN SPACE**

T. SCRATCHERD and D. GRUNDY (Sheffield, University, England) *British Interplanetary Society, Journal* (ISSN 0007-084X), vol. 42, Aug. 1989, p. 357-359.

Several physiological problems associated with space flight are reviewed. Consideration is given to the characteristics of the space vehicle environment, the physiological response to space flight, and the effects of microgravity on the muscles. Also, the effects on red blood cells and hemoglobin, the process of readapting to earth conditions, and the psychological effects of a stressful environment are discussed. R.B.

A89-50739**EXPOSURE TO ACCELERATION DURING MANNED SPACEFLIGHT**

C. C. HARLING (Sheffield, University, England) *British Interplanetary Society, Journal* (ISSN 0007-084X), vol. 42, Aug. 1989, p. 360-362.

The physiological effects of increased acceleration during ascent and descent in spaceflight are described. The cardiovascular effects of acceleration are emphasized. Methods for physiological and external protection from adverse effects of acceleration are examined. The acceleration profiles of various space flights, including Space Shuttle flights, are compared. It is found that the threshold for astronaut safety is an acceleration rate of about $\pm 15G/s$. R.B.

A89-50740**WATER AND SALT DISTURBANCES UNDER CONDITION OF MICROGRAVITY**

IAN W. HENDERSON (Sheffield, University, England) *British*

Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Aug. 1989, p. 363-366. refs

Under conditions of microgravity severe alterations in body fluid composition and volume take place largely as a result of 'cardiothoracic pooling' or headward shift of blood. Inappropriate endocrine, renal and cardiovascular responses result from the 'misreading' of homeostatic signals by physiological receptors to produce an as yet incompletely defined syndrome under microgravitational conditions.

Author

A89-50741

THE EFFECTS OF SPACE TRAVEL ON THE NERVOUS SYSTEM

A. ANGEL (Sheffield, University, England) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Aug. 1989, p. 367-370.

The translation of man from terrestrial to an extra terrestrial environment is accompanied by an upset in the servocontrol of movement engendered by the removal of the normal gravitational signal. Unfortunately the natural response of the nervous system to ocular and vestibular confusion is to cause varying degrees of sickness which can only be avoided by choice of suitable space travelers, i.e., those who are least upset by gravitational chaos. This will remain so until much more is learned about the fundamental physiological mechanisms whereby man maintains a correct head/trunk, head/eye, trunk/limb and eye/limb positional coordination and why, if these are upset, man's natural response is to vomit.

Author

A89-50742

CALCIUM METABOLISM AND THE OSTEOPENIA OF SPACE FLIGHT

T. SCRATCHERD and D. GRUNDY (Sheffield, University, England) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Aug. 1989, p. 371-373. refs

Bone remodeling and calcium homeostasis are discussed, focusing on the changes that occur in the microgravity environment. The results from studies of the urinary and fecal calcium concentrations in astronauts during spaceflight are reviewed. The potential hazard of bone calcium loss during spaceflight are evaluated and countermeasures against these hazards are considered.

R.B.

A89-50743

FOOD FOR THOUGHT - NUTRITIONAL PROBLEMS IN SPACE

D. GRUNDY and T. SCRATCHERD (Sheffield, University, England) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Aug. 1989, p. 374-377. refs

The nutritional requirements during spaceflight are examined, emphasizing the ways in which microgravity may alter these requirements. The protein, fat, and carbohydrate requirements during spaceflight are considered. The primary functions of vitamins and minerals are reviewed. The daily dietary requirements of a 70-kg man in space are estimated. The nutritional issues related to long-duration space missions are discussed.

R.B.

A89-50744

EFFECTS OF SPACE TRAVEL ON SEXUALITY AND THE HUMAN REPRODUCTIVE SYSTEM

R. J. LEVIN (Sheffield, University, England) British Interplanetary Society, Journal (ISSN 0007-084X), vol. 42, Aug. 1989, p. 378-382. refs

The possible effects of spaceflight on human sexuality and reproduction are examined, including the effects of stress, weightlessness, and radiation. The effects of space travel on spermatogenesis, sex ratio, menstruation, ovulation, fertilization, and fetal development are considered. Issues related to the behavioral aspects of human sexuality and long-duration spaceflight are discussed.

R.B.

A89-50868

VOLUME- AND RESISTANCE-RELATED LOADS ON THE HEART DUE TO GRAVITATIONAL OVERLOADS AND WEIGHTLESSNESS - THEORETICAL STUDIES (PRED- I POSTNAGRUZKA NA SERDTSE PRI GRAVITATSIONNYKH PEREGRUZHAKH I V SOSTOIANII NEVESOMOSTI - TEORETICHESKIE ISSLEDOVANIYA)

B. L. PALETS Kosmicheskaya Nauka i Tekhnika (ISSN 0321-4508), no. 3, 1988, p. 90-94. In Russian. refs

The hemodynamic loads on the heart in simulated transition to weightlessness and gravitational overloads are investigated by using a mathematical model of circulation. It is shown that volume-related loads and resistance-related loads on the pulmonary ventricle reach a maximum in weightlessness, whereas resistance-related loads on the aortic ventricle are a maximum under conditions of gravitational overloads.

V.L.

A89-50867

A MATHEMATICAL MODEL OF THE DYNAMICS OF THE CUPULA-ENDOLYMPH SYSTEM (MATEMATICHESKAYA MODEL' DINAMIKI KUPULO-ENDOLIMFATICHESKOI SISTEMY)

A. V. KONDRACHUK and S. P. SIRENKO Kosmicheskaya Nauka i Tekhnika (ISSN 0321-4508), no. 3, 1988, p. 94-99. In Russian. refs

A mathematical model of the cupula-endolymph system, a portion of the vestibular analyzer registering angular accelerations, is presented. An equation of cupula motion is obtained which is reduced to the well-known Steinhausen equation in the thin channel approximation when the density difference of the cupula and the endolymph is zero. It is shown that, under complex dynamic conditions, the nonzero difference of the cupula and endolymph densities produces certain singularities in cupula dynamics which contribute to the dysfunction of the vestibular analyzer in space flight.

V.L.

A89-50900

CAPACITY FOR PHYSICAL WORK IN MOUNTAIN CLIMBERS UNDER CONDITIONS OF EXTREMELY LOW PO2 IN INSPIRED AIR (FIZICHESKAYA RABOTOSPOSOBNOST' AL'PINISTOV V USLOVIYAKH EKSTREMAL'NO NIZKOGO PO2 VO VDYKHAEMOM VOZDUKHE)

A. Z. KOLCHINSKAYA, P. V. BELOSHITSKII, V. D. MONOGAROV, R. V. PIVNUTEL', P. A. RADZIEVSKII (AN USSR, Institut Fiziologii, Kievskii Gosudarstvennyi Institut Fizicheskoi Kul'tury, Kiev, Ukrainian SSR) et al. Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 35, May-June 1989, p. 68-74. In Russian. refs

Results are presented on measurements of work capacity in trained mountain climbers subjected to conditions of high-altitude mountain climbing (work on a bicycle ergometer at altitudes of 2100, 3500, 4200, 5120, and 7500 m, corresponding to oxygen pressures of 130, 103, 92, 83, and 61 mm Hg, respectively). The levels of work capacity were estimated from measurements of the subjects' strength, oxygen consumption, CO2 release, and various physiological parameters. It was found that highly trained mountain climbers retained high work capacity even under conditions of extremely low pO2. At the pO2 level equal to 61 mm, many subjects could carry out work which at sea level is considered to be of intermediate difficulty. The levels of work capacity at low pO2 depended on the subject's individual characteristics and the length of training.

I.S.

A89-51013

CAUSES OF THE DECLINE OF THE STATE OF WELL-BEING OF PILOTS DURING FLIGHT. I (PRICHINY UKHUDSHENIYA SAMOCHUVSTVIA LETCHIKOV V POLETE. I)

V. E. ASTREBOV and V. V. SHCHERBINSKII Voenno-Meditsinskii Zhurnal (ISSN 0026-9050), April 1989, p. 53-55. In Russian. refs

Symptoms of abrupt decline in the state of well-being of pilots during flight, associated with a decline in work capacity, are discussed, together with possible causes of these conditions. Among the factors considered to be the primary causes are high-G acceleration and other factors of navigation, hyperventilation, the

loss of spatial orientation, hypoglycemia, emotional factors, neurovegetative dystonia, hypothyria, and organic diseases. Among symptoms characterizing pilots that are likely to experience a deterioration of the state of well-being in flight are asymptotic ischemic heart disorders and various functional physiological and psychological deviations. I.S.

N89-27330# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

SHORT COURSE ON CARDIOPULMONARY ASPECTS OF AEROSPACE MEDICINE

G. W. GRAY, ed. (Defence and Civil Inst. of Environmental Medicine, Toronto, Ontario) May 1989 81 p
(AGARD-R-758-ADD; ISBN-92-835-0497-6; AD-A181677) Avail: NTIS HC A05/MF A01

AGARD Report 758, Short Course on Cardiopulmonary Aspects of Aerospace Medicine, presented the lecture material and case history information from a Short Course by the Aerospace Medical Panel during Spring 1987. This Addendum presents the discussions which took place throughout the duration of the Short Course.

Author

N89-27331# Letterman Army Inst. of Research, San Francisco, CA.

MERIDIAN VARIATIONS IN SPECTRAL DARK ADAPTATION Report, 14 Feb. - 14 Mar 1989

O. JOSEPH CALABRESE and HARRY ZWICK Mar. 1989 27 p

(AD-A207248; AD-E801886; LAIR-372) Avail: NTIS HC A03/MF A01 CSCI 06/4

Spectral dark adaptation as a function of retinal meridian and of eccentricity was investigated by testing the absolute threshold dark adaptation curves for eight human volunteers at two retinal meridians. The horizontal and vertical meridians. The horizontal and vertical meridians separately and together at eccentricities of 2 degrees and 16 degrees from a fixation point were studied. A microprocessor-operated dark adaptometer was used, and analysis of variance was performed on the data. The study indicated that meridian differences in the dark-adapted retina exist and that the horizontal meridian is more sensitive than the vertical meridian when the retina is tested at 16 degrees with medium wavelength light. This may indicate meridian differences in photoreceptor distribution. GRA

N89-27332# Army Research Inst. of Environmental Medicine, Natick, MA.

ALTITUDE SYMPTOMATOLOGY AND MOOD STATES DURING A CLIMB TO 3630 M

BARBARA S. HALE, TERRY M. RAUCH, and RICHARD FOUTCH Apr. 1989 18 p
(AD-A208261; USARIEM-M41-89) Avail: NTIS HC A03/MF A01 CSCI 06/10

Ascents to altitude above 3050 m have been shown to cause adverse changes in symptoms and moods. It is thought that the severity of these changes not only depends on the altitude and rate of climb, but also on the length of stay and the effort expended to reach the desired altitude. In order to better understand how these factors influence symptom and mood changes during a climb, this study systematically assessed symptoms and moods during an ascent to 3630 m. Seven symptom factors and two mood factors were found to be adversely affected over time by the changes in altitude. More specifically, the subjects experienced more respiratory acute mountain sickness (AMS), exertion stress, and muscular discomfort and they were also colder, less alert, less vigorous, and more fatigued at higher elevations. These changes occurred primarily at 3630 m and most also occurred at 3080 m. The changes were always different from the values on the second day at 2225 m and they sometimes differed from the values on the first day at 2225 or 2530 m. Therefore, this study demonstrated that a climb to 3630 m produces adverse changes in symptomatology and mood states and that factors other than just level of altitude can affect these parameters. GRA

N89-27333# Army Research Inst. of Environmental Medicine, Natick, MA.

ANNUAL HISTORICAL REPORT - AMEDD ACTIVITIES

1988 108 p

(AD-A208301; RCS-MED-41(R4)) Avail: NTIS HC A06/MF A01 CSCI 06/10

The Mission of the U.S. Army Research Institute of Environmental Medicine is to conduct research on the effects of temperature, altitude, work and nutrition on the health and performance of the individual soldier and combat crews operating Army systems. It assesses decrements to soldier or combat crew performance caused by the synergy of environmental extremes protective measures. It conducts research on the biomedical processes limiting physical performance to determine physical fitness requirements and seek solutions to medical problems related to physical training and exercise. It defines the complex interaction of environmental/operational stress and Army systems and develops, evaluates and assists in the implementation of strategies designed to protect the soldier and enhance performance. In coordination with the Natick Research, Development and Engineering Center (Natick) and through liaison with other Federal agencies, USARIEM conducts research to develop the technology base required to evaluate feeding strategies for operation rations and supplements to minimize soldier performance decrements under sustained combat conditions and discharge the Army Surgeon General's responsibilities as LCD executive agent for nutrition. Assists Natick in the development of personal clothing and equipment. GRA

N89-27334# Army Research Inst. of Environmental Medicine, Natick, MA.

THERMOREGULATORY RESPONSES IN THE COLD-EFFECT OF AN EXTENDED COLD WEATHER CLOTHING SYSTEM (ECWCS)

RICHARD R. GONZALEZ, THOMAS L. ENDRUSICK, and WILLIAM L. SANTEE Apr. 1989 35 p Presented at the 15th Commonwealth Defence Conference on Operational Clothing and Combat Equipment, Canada, 1989
(Contract DA PROJ. 3E1-62787-A-878)
(AD-A208314; USARIEM-M42-89) Avail: NTIS HC A03/MF A01 CSCI 06/19

The human thermoregulatory responses of wearing a new cold-weather system (ECWCS) at rest or during exercise is addressed. The ECWCS (insulation 3.6 clo, weight 10.1 kg) encompasses skin-tight polypropylene underwear, polyester/cotton fatigues, polyester-insulated liners, balaclava, vapor-barrier boots, and polytetrafluorethylene (PTFE)-lined outer garments. Six fit males each rested and did treadmill exercise while wearing different handwear with the ECWCS; the handwear included: a light duty glove heavy duty glove, or an Arctic mitten. A maximal 120 min cold challenge for each soldier was designated (based on physiological safety measures) as a maximal endurance time (ET,min). A multiple correlation analysis demonstrated that ET could be predicted adequately by finger temperature, absolute metabolism, rectal and 10-site skin temperatures. Effect of sweating during exercise reduced the effective thermal insulation of the ensemble thereby lowering the ET's for each handwear item. The Arctic mitten rendered the highest ET's during rest or exercise. The ECWCS should tender adequate endurance times in cold-dry ambients provided that ventilation and removal of extra layers is allowed as an easy option during heavy exercise so that thermal insulation is not excessively decreased by body moisture. GRA

N89-27335# Army Research Inst. of Environmental Medicine, Natick, MA.

CONSIDERATIONS FOR REPLACEMENT BEVERAGES: FLUID-ELECTROLYTE BALANCE AND HEAT ILLNESS Report, period ending Feb. 1989

LAWRENCE E. ARMSTRONG 28 Feb 1989 18 p
(AD-A208342; USARIEM-M32-89) Avail: NTIS HC A03/MF A01 CSCI 06/8

This article emphasizes the specific need (or lack of need) for carbohydrate-electrolyte solutions, which soldiers experience

during duty in hot environments. Because this article focuses on fluids and electrolytes, it is helpful to reiterate the following aspects of their reports: (1) Gatorade was used in dilute form, at 2/3 (Alltz) and 1/4 (Donovan) strength, (2) meals were sacrificed so that the mission could be accomplished, and (3) a rigorous hydration program virtually eliminated heat illness at a time when the other U.S. personnel experienced significant casualties. Carbohydrate-electrolyte replacement fluids may be necessary in some, but not all, military field situations. The greatest need for carbohydrate-electrolyte replacement fluids will be experienced by soldiers who: (1) lose more than 8 L of sweat per day; (2) are not heat acclimatized (e.g., during the initial 8 days of field living); (3) are performing a prolonged, continuous exercise bout (greater than 60 min); (4) skip meals, have meals interrupted, or encounter anorexia due to a hot environment; (5) experience a caloric deficit greater than 1000 Kcal/day; or (6) are ill with diarrheal disease. The fluid-electrolyte needs of soldiers will be specific to the intensity, frequency and duration of the exercise involved, as well as the environmental stress encountered. GRA

N89-27336# Army Research Inst. of Environmental Medicine, Natick, MA. Exercise Physiology Div.

ENDOGENOUS HORMONAL AND GROWTH FACTOR RESPONSES TO HEAVY RESISTANCE EXERCISE PROTOCOLS

WILLIAM J. KRAEMER, LOUIS MARCHITELLI, DINI MCCURRY, ROBERT MELLO, JOSEPH E. DZIADOS, EVERETT A. HARMAN, PETER N. FRYKMAN, SCOTT E. GORDON, and STEVEN J. FLECK 20 Mar. 1989 29 p Submitted for publication Prepared in cooperation with Connecticut Univ., Storrs; and US Olympic Committee, Colorado Springs, CO (AD-A208375) Avail: NTIS HC A03/MF A01 CSCL 06/10

To examine endogenous anabolic hormone and growth factor responses to various heavy resistance exercise protocols (HREPs), nine male subjects performed each of six randomly assigned HREPs which consisted of identically ordered exercises carefully designed to control for load (5RM vs 10RM), rest period length (1 min vs 3 min) and total work (J) effects. Serum human growth hormone (hGH), testosterone (T), somatomedin-C (SM-C), serum glucose and whole blood lactate (HLA) concentrations were determined pre-exercise, mid-exercise and at 0, 5, 15, 20, 60, 90, and 120 min post-exercise. All HREPs produced significant increases in serum T concentrations although the magnitude and frequency above resting values varied across HREPs. The highest hGH concentrations were observed consequent to high total work, 1 min rest periods and 10RM load. All HREPs did not produce increases in serum hGH. The pattern of SM-C increases varied among HREPs and did not follow hGH changes. These data suggest that the release patterns and the magnitude of increases are functions of the type of HREPs utilized. Thus, all HREPs may not effect muscle and connective tissue growth in the same manner due to differences in hormonal and growth factor responses. GRA

N89-27337# Army Research Inst. of Environmental Medicine, Natick, MA.

EFFECTIVENESS AND ACCEPTABILITY OF NUTRIENT SOLUTIONS IN ENHANCING FLUID INTAKE IN THE HEAT

MADELEINE S. ROSE, PATRICA C. SZLYK, RALPH P. FRANCESCONI, LAURIE S. LESTER, LAWRENCE E. ARMSTRONG, WILLIAM MATTHEW, ARMAND V. CARDELLO, RICHARD D. POPPER, INGRID SILS, GLENN THOMAS et al. 18 Nov. 1988 252 p (AD-A208428; USARIEM-T-10/89) Avail: NTIS HC A12/MF A01 CSCL 06/8

Two colored, flavored, 2.5 percent carbohydrate-electrolyte solutions (Armyade and NBC Nutrient solution) with varying level of magnesium, potassium, and phosphorus were tested for ad libitum consumption and acceptability during 8 days of work in a hot environment. Sixty-one male and female soldiers were divided into 4 test groups. A Control group drank water while the remaining three groups were given one of the following test beverages: NBC

Nutrient solution Armyade, or a colored flavored water (placebo). All four groups were allowed to consume other fluids such as plain water, soda, juice, etc. Acceptability in terms of hedonic ratings and consumption rate was determined. There were no group difference in terms of energy intake. Urine specific gravity and electrolytes, body weight, and fluid intake were monitored twice daily to assess hydration status. Drinking NBC and Armyade solutions appeared to be safe under the conditions studied. The ability to measure heat stress levels across a large area would provide valuable information for optimizing soldier performance. The close correlation between field and satellite-derived WBGT readings during the field trial indicates significant potential for the use of satellite remote sensing technology to accurately assess WBGT in training/operational environments. GRA

N89-28199# Los Alamos National Lab., NM.

THE HUMAN TELOMERE

ROBERT K. MOYZIS 1989 15 p Presented at the 6th Conversation in the Discipline Biomolecular Stereodynamics, Albany, NY, 6 Jun. 1989 (Contract W-7405-ENG-36) (DE89-014252; LA-UR-89-1989; CONF-8906159-2) Avail: NTIS HC A03/MF A01

An ultimate goal of human genetics is the generation of a complete physical and functional map of the human genome. Twenty-five percent of human DNA, however, consists of repetitive DNA sequences. These repetitive DNA sequences are thought to arise by many mechanisms, from direct sequence amplification by the unequal recombination of homologous DNA regions to the reverse flow of genetic information. A general outline of the chromosomal organization of these repetitive sequences will be discussed. Our working hypothesis is that certain classes of human repetitive DNA sequences encode the information necessary for defining long-range genomic structure. Evidence will be presented that the first goal of this research, the identification and cloning of the human telomere, has been achieved. A human repetitive DNA library was constructed from randomly sheared, reassortated, and oligo(G-C)-tailed DNA, a method that minimizes the potential loss of sequences devoid of a given restriction enzyme site. Sequences too large to clone efficiently in cosmid or lambda vectors, such as centromeric repeats, or telomeric sequences with an end incompatible for cloning, should be present in this library. In order to isolate highly conserved repetitive DNA sequences, this library was screened with radiolabeled hamster Cot50 repetitive DNA. Two clones, containing tandem arrays of the sequence (TTAGGG)_n, were isolated by this method. DOE

N89-28200# Aerospace Medical Research Labs., Wright-Patterson AFB, OH.

THE EFFECT OF VARIOUS STRAINING MANEUVERS ON CARDIAC VOLUMES AT 1G AND DURING +GZ

ACCELERATION Final Report, Jan. 1984 - Aug. 1985 TOM JENNINGS, LLOYD TRIPP, LORA HOWELL, JOHN SEAWORTH, and DAVID RATINO Jan. 1989 20 p (AD-A208846; AAMRL-TR-89-011) Avail: NTIS HC A03/MF A01 CSCL 06/5

The purpose of this study was to evaluate the effect of Valsalva (Val), isometric contraction (Iso) and the L-1 maneuvers (L-1) on cardiac volumes at 1G and during 4G. Two-dimensional echocardiography was used to measure volumes. 1G Phase: Eight seated male subjects performed the three maneuvers. The end-diastolic volume (EDV) decreased during Val and L-1 (p less than 0.05). EDV decreased initially but then returned to baseline with Iso. 4G Phase: Seven male subjects experienced three 30 second 4G epochs while performing the three maneuvers. During 4G, 3 of 7 performing Val, 2 of 7 performing Iso, and none performing L-1, experienced peripheral light loss. EDV decreased and stabilized below baseline during the 4Gz epoch (p less than 0.05). Heart rate and cardiac output increased for all maneuvers. Differences between the effects of Val, Iso, and L-1 on G-tolerance do not appear to be related to a differential ability to maintain cardiac volumes. L-1 must provide more G protection due to the

isometric contraction component of the maneuver and provide more G protection due to the isometric contraction component of the maneuver and its ability to increase blood pressure. GRA

N89-28201# Army Research Inst. of Environmental Medicine, Natick, MA. Health and Performance Div.

EFFECTS OF HIGH TERRESTRIAL ALTITUDE ON MILITARY PERFORMANCE

LOUIS E. BANDERET and RICHARD L. BURSE 18 Apr. 1989 45 p
(AD-A209614; USARIEM-M-33-89) Avail: NTIS HC A03/MF A01 CSCI 06/4

At high altitude, several adverse physical characteristics make coping, functioning, and survival very difficult: hypoxia, cold, wind, dryness, solar radiation, and ultraviolet radiation. The proportion of oxygen in the air is constant at 20.93 percent, even at altitudes up to 100,000 m. The decreased atmospheric pressure at high altitudes results in a proportional reduction of the partial pressure of oxygen (Po₂). This lessens the amount of oxygen carried on the blood. The barometric pressures of two regions at the same elevation may differ, since atmospheric pressure also depends on latitude, thickness of the earth's crust, and weather. The relationship between altitude and atmospheric pressure is described in table which include adjustment factors for specific location conditions. GRA

N89-28202# Army Research Inst. of Environmental Medicine, Natick, MA.

ACETYLCHOLINESTERASE INHIBITOR, PYRIDOSTIGMINE BROMIDE, REDUCES SKIN BLOOD FLOW IN HUMANS

LOU A. STEPHENSON and MARGARET A. KOLKA May 1989 26 p
(AD-A209615; USARIEM-M-49-89) Avail: NTIS HC A03/MF A01 CSCI 06/15

Five subjects exercised on a cycle ergometer for 30 min at 55 percent peak VO₂ on two occasions in a slightly warm environment. Pyridostigmine bromide (PYR), an acetylcholinesterase (AChE) inhibitor, was ingested (30 mg) approximately 150 min before one experiment, and no drug was administered during the other experiment (control). Red cell AChE inhibition averaged 40 (+ or - 7) percent during PYR treatment. Esophageal temperature (T_{es}), a derived mean skin temperature, forearm blood flow (venous occlusion plethysmography), cutaneous perfusion, and metabolic rate were measured. Cutaneous perfusion decreased after PYR treatment compared to control. Forearm blood flow, which included inactive muscle, skin, fat and bone tissue, was not different between treatments, which implies that blood flow to one of those tissues may have increased while skin blood flow decreased during PYR treatment. The increased threshold for initiation of cutaneous vasodilation with AChE inhibition by PYR suggests that the drug activates central modulation of thermoregulation. One of several possible mechanisms activated may be through increased ACh accumulation at preganglionic sites. This could potentiate adrenergic transmission to cutaneous blood vessels, and enhance vasoconstrictor tone. GRA

N89-28203# Rutgers - The State Univ., New Brunswick, NJ. Dept. of Psychology.

EYE MOVEMENTS AND VISUAL INFORMATION PROCESSING

Interim Report, 1 Apr. 1988 - 31 Mar. 1989
EILEEN KOWLER 27 Apr. 1989 3 p
(Contract AF-AFOSR-0171-88; AF PROJ. 2313)
(AD-A209817; AFOSR-89-0808TR) Avail: NTIS HC A02/MF A01 CSCI 05/8

Eye movements place a limit on the processing of visual information because they determine the location and the velocity of the retinal image. Thus, to understand how we see it is necessary to understand how eye movements are controlled. Work this year in my laboratory has concentrated on the roles of expectations and selective attention in the programming of smooth and saccadic eye movements. We have: (1) demonstrated distinct roles for past experience and expectations in the control of smooth eye movement and found that expectation will predominate in the

presence of cues about the direction of future motion; (2) found that brisk initial pursuit requires that expectation that target motion will continue; and (3) showed that saccadic eye movements are not attracted to visual backgrounds (as had been claimed) unless subjects pay attention to the background. These studies show that central representations of visual scenes, containing information about the position, motion and future motion of selected objects, are the natural effective stimulus for human eye movement. GRA

N89-28204# Colorado State Univ., Fort Collins.

THE PHOTOTOXICITY OF BLUE LIGHT ON THE FUNCTIONAL PROPERTIES OF THE RETINAL PIGMENT EPITHELIUM

Annual Report, 1 May 1988 - 30 Apr. 1989

E. L. PAULTER May 1989 17 p
(Contract AF-AFOSR-0189-87; AF PROJ. 2312)
(AD-A209834; AFOSR-89-0930TR) Avail: NTIS HC A02/MF A01 CSCI 06/10

The phototoxic effect of blue light on isolated pigment epithelium was investigated. The emphasis was on functional changes rather than a description of pathology. The pigment epithelium is analogous to the blood-brain barrier; therefore, the principal functions investigated were the integrity of the barrier system and the transport system and the transport systems known to operate in the pigment epithelium. The effects of blue light on leucine transport across the isolated bovine retinal pigment epithelium (RPE) were continued to determine if Vitamin E and melatonin provided any protective action. Similar studies on the transport of glutamate in the retina to choroid direction were also completed. GRA

N89-28205# New York Univ., New York. Dept. of Psychology. **HIGHER ORDER MECHANISMS OF COLOR VISION Progress Report No. 1, 15 Sep. 1986 - 14 Mar. 1989**

JOHN KRAUSKOPF 12 May 1989 16 p
(Contract AF-AFOSR-0334-86; AF PROJ. 2313)
(AD-A209838; AFOSR-89-0931TR) Avail: NTIS HC A02/MF A01 CSCI 06/4

The main accomplishments during this reporting period were: (1) a comprehensive study of the effects of chromatic content, blur and contrast of targets on vernier acuity and on stereo acuity; (2) the use of a new method of measuring chromatic discrimination under conditions of constant adaptation; (3) continuation of the study of the chromatic properties of single cells in the monkey cortex; and (4) experiments on the significance color in the perception of motion. GRA

N89-28206# Johns Hopkins Univ., Baltimore, MD.

PRE-ATTENTIVE AND ATTENTIVE VISUAL INFORMATION PROCESSING Annual Report, 2 Apr. 1988 - 3 Mar. 1989

H. E. EGETH 1 Jun. 1989 17 p
(Contract AF-AFOSR-0180-87; AF PROJ. 2313)
(AD-A209884; AFOSR-89-0815TR) Avail: NTIS HC A03/MF A01 CSCI 06/4

Research on several interrelated topics is described. These projects are focused on the analysis of feature and conjunction detection, models of selective attention, and curve tracing. One project examines the effects of a heterogeneous background on feature search. Another assesses spatial factors (such as target-distractor separation) in the detection of targets defined in terms of simple features. A third project has the goal of developing methods for determining the extent to which processing is serial or parallel. A fourth represents initial efforts to determine whether conjoined features are represented in retinotopic or spatiotopic maps. A fifth explores top-down and bottom-up factors in visual search. A sixth makes use of an inhibitory priming method to test early- and late-selection models of selective attention. Finally, a project is reported in which the operation of visual curve tracing is studied. GRA

N89-28207# New York Univ., New York.

ATTENTION, IMAGERY AND MEMORY: A NEUROMAGNETIC INVESTIGATION Annual Report, 1 Mar. 1988 - 28 Feb. 1989

LLOYD KAUFMAN 12 May 1989 7 p
(Contract F49620-88-K-0004)
(AD-A209917; AFOSR-89-0960TR) Avail: NTIS HC A02/MF A01
CSCL 05/8

This report describes a number of experiments related to the effects of mental imagery and other high-level cognitive tasks on the spontaneous activity of the brain. The basic procedure involves narrowly bandpassing the magnetoencephalogram (MEG), computing the average response to a stimulus or event within that bandpass, and computing the variance around the average. The variance at any point in time subsequent to the stimulus is a measure of mean square field (power). Power in the alpha band (8 to 12 Hz) was found to show a prominent change in level subsequent to presentation of form. Simply watching the form results in a dip in alpha power, but when subjects attempt to determine if the form had been seen previously, the duration of the reduction in alpha power increases significantly, and is correlated with reaction time (RT). In an experiment subjects tried to form an image of an object represented by a visually presented word, or to find a rhyming word. The latter task did not produce a change in activity of visual cortex, while the same words produced a profound change in activity cortex during imaging. Acoustically presented words were also found to produce changes in MEG activity. GRA

N89-28208# New York Univ., New York. Dept. of Physics and Psychology.

MODULATION OF SPONTANEOUS BRAIN ACTIVITY DURING MENTAL IMAGERY Report, 1 Mar. 1988 - 28 Feb. 1989

LLOYD KAUFMAN, BARRY SWARTZ, CARLO SALUSTRI, and SAMUEL J. WILLIAMSON 12 May 1989 14 p
(Contract F49620-88-K-0004)
(AD-A209918; AFOSR-89-0961TR) Avail: NTIS HC A03/MF A01
CSCL 06/4

Magnetic measurements of average power of human alpha activity over the occipital and parietal areas of the scalp reveal spatially selective suppression when abstract figures are briefly presented visually. The duration of suppression increases along with reaction time during a search of visual memory. This implies that the visual system is involved in mental imagery. GRA

N89-28209# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.

OPTICAL SPATIAL TRACKING USING COHERENT DETECTION IN THE PUPIL PLANE

ERIC A. SWANSON, GARY M. CARTER, D. J. BERNAYS, and DAVID M. HODSDON 19 May 1989 41 p
(Contract F19628-85-C-0002)
(AD-A209970; TR-823) Avail: NTIS HC A03/MF A01 CSCL 17/5

Design considerations for a heterodyne spatial tracking system utilizing pupil-plane processing techniques and its advantages over traditional focal-plane processing are described. Noise performance bounds, optimal and suboptimal local oscillator distributions, pull-in performance, and applications other than spatial tracking are discussed. Experimental verification of a one-axis closed-loop tracking system is presented. GRA

N89-28210# New York Univ., New York. Dept. of Physics and Psychology.

VISUALIZING AND RHYMING CAUSE DIFFERENCES IN ALPHA SUPPRESSION Report, 1 Mar. 1988 - 28 Feb. 1989

LLOYD KAUFMAN, M. GLANZER, Y. CYCOWICZ, and S. J. WILLIAMSON 12 May 1989 5 p
(Contract F49620-88-K-0004; F49620-86-C-0141; AF PROJ. 2313)
(AD-A210005; AFOSR-89-0962TR) Avail: NTIS HC A02/MF A01
CSCL 06/4

Alpha rhythms of the EEG are strongest at the occipital regions of the head, and the visual cortex is apparently a major contributor. It has been suggested that visual cortex is involved in forming and processing mental images. The purpose of this experiment is to determine if a task that involves visualizing objects represented by words produces changes in alpha rhythms of the MEG that

differ from changes associated with finding rhymes of the same or related verbal stimuli. By hypothesis, the visual areas of the cortex play a less prominent role in the latter task than they do in the visualizing task. This inference is consistent with the finding that visual imagery is accompanied by attenuation of the alpha rhythm over the occipital scalp, in the proximity of visual cortex cognitive factors, such as memorization and classification of words, affects the pattern of alpha blockage across the occipital and parietal area, but this does not establish that visual cortex per se is involved. Subjects responded by forming mental images of the objects represented by the words. The event related potentials associated with presentation of the words were larger in amplitude than they were when the subjects silently pronounced words that rhymed with the stimuli instead of forming mental images. This effect was more evident at occipital electrodes than it was at other locations. There may well be differential suppression of alpha activity depending on the degree to which visual resources are engaged in various mental tasks, such as imaging. GRA

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BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A89-48374* Georgia State Univ., Atlanta.

NOTE ON HAND USE IN THE MANIPULATION OF JOYSTICKS BY RHESUS MONKEYS (MACACA MULATTA) AND CHIMPANZEES (PAN TROGLODYTES)

WILLIAM D. HOPKINS, DAVID A. WASHBURN, and DUANE M. RUMBAUGH (Georgia State University; Emory University, Atlanta) Journal of Comparative Psychology (ISSN 0735-7036), vol. 103, no. 1, 1989, p. 91-94. Research supported by NIH. refs
(Contract NAG2-438)

MacNeillage et al. (1987) have proposed that nonhuman primate handedness may be contingent on the specific task requirements, with visual-spatial tasks yielding left-hand preferences and fine-motor tasks producing right-hand preferences. This study reports hand preferences in the manipulation of joysticks by 2 rhesus monkeys and 3 chimpanzees. Reach data were also collected for comparison with preference data for manipulation of the joystick. The data indicated that all 5 subjects demonstrated significant right-hand preferences in manipulating the joystick. In contrast, no significant hand preferences were found for the reach data. Reaction-time data also indicated that the right hand could perform a perceptual-motor task better than the left hand in all 5 subjects. Overall, the data indicate that reach tasks may not be sensitive enough measures to produce reliable hand preferences, whereas tasks that assess fine-motor control produce significant hand preferences. Author

A89-48375* Georgia State Univ., Atlanta.

RHESUS MONKEYS (MACACA MULATTA), VIDEO TASKS, AND IMPLICATIONS FOR STIMULUS-RESPONSE SPATIAL CONTIGUITY

DUANE M. RUMBAUGH, W. KIRK RICHARDSON, DAVID A. WASHBURN, WILLIAM D. HOPKIN (Georgia State University, Atlanta), and E. SUE SAVAGE-RUMBAUGH (Georgia State University; Emory University, Atlanta) Journal of Comparative Psychology (ISSN 0735-7036), vol. 103, no. 1, 1989, p. 32-38. refs
(Contract NAG2-438; NIH-06016)

Recent reports support the argument that the efficiency of primate learning is compromised to the degree that there is spatial discontinuity between discriminands and the locus of response. Experiments are reported here in which two rhesus monkeys easily mastered precise control of a joystick to respond to a variety of computer-generated targets despite the fact that the joystick was located 9 to 18 cm from the video screen. It is argued that

stimulus-response contiguity is a significant parameter of learning only to the degree that the monkey visually attends to the directional movements of its hand in order to displace discriminands. If attention is focused on the effects of the hand's movement rather than on the hand itself, stimulus-response contiguity is no longer a primary parameter of learning. The implications of these results for mirror-guided studies are discussed. C.D.

A89-48437#

MAPPING LABORATORY TESTS TO IN-FLIGHT TASKS

VALERIE J. GAWRON, LOUIS H. KNOTTS (Calspan Advanced Technology Center, Buffalo, NY), and SAMUEL G. SCHIFFLETT IN: AIAA Flight Simulation Technologies Conference and Exhibit, Boston, MA, Aug. 14-16, 1989, Technical Papers. Washington, DC, American Institute of Aeronautics and Astronautics, 1989, p. 462-469. refs

(AIAA PAPER 89-3331)

Much research is being conducted to identify the effects of drugs on pilot performance. Some of this research is conducted in the laboratory, some in-flight. Often the results of the laboratory and in-flight studies are not the same. The sources of these differences can include: different subjects, additional stressor effects of flight, and an inadequate mapping of the laboratory and flight tasks. The first source can be eliminated by a strong experimental design. The effects of the second source can be interpolated from multistressor laboratory experiments. The third source can be eliminated by using a special set of laboratory tasks and a validated mapping scheme. Both of these are described in the following paper. Author

A89-48818

DETECTION EFFICIENCY ON AN AIR TRAFFIC CONTROL MONITORING TASK WITH AND WITHOUT COMPUTER AIDING

RICHARD I. THACKRAY and R. MARK TOUCHSTONE (FAA, Civil Aeromedical Institute, Oklahoma City, OK) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Aug. 1989, p. 744-748. refs

Future levels of air traffic control automation will incorporate computer-aided features designed to alert the controller by displaying information that will identify upcoming problems and suggest solutions. Concerns have been expressed that reliance on such aids may lead to a reduced capacity by controllers to detect and respond to computer failure. The present study employed a simulated ATC monitoring task with a computer feature designed to detect possible aircraft conflicts. The ability of subjects to detect occasional failures of the computer feature in detecting problem situations was compared with detection efficiency for these same situations when no computer aiding was provided. The hypothesis that alertness would be lower and detection less efficient with computer aiding than when no aiding was employed was not supported. Applications and limitations of the findings to the problem of complacency in automated systems are discussed. Author

A89-48825

BEHAVIOURAL SCIENCE AND OUTER SPACE RESEARCH

A. J. W. TAYLOR (Wellington, Victoria University, New Zealand) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 60, Aug. 1989, p. 815, 816. refs

This paper notes the awakening interest of NASA in the potential inclusion of behavioral scientists in the U.S. space program, but expresses the fear that unless a major shift occurs in the attitudes of some key personnel the outcome might not be as promising as otherwise possible. It mentions the complete neglect of psychological research in the Skylab studies, and, drawing from the analogous Antarctic situation of small group isolation, suggests a way in which leeway could be made ready for the pending long-duration and Space-Station projects. Author

A89-50573

A COMPARISON OF CLASSIFICATION ALGORITHMS IN TERMS OF SPEED AND ACCURACY AFTER THE APPLICATION OF A POST-CLASSIFICATION MODAL FILTER

D. J. BOOTH (Aston University, Birmingham, England) and R. B. OLDFIELD (Numerical Algorithms Group, Ltd., Oxford, England) International Journal of Remote Sensing (ISSN 0143-1161), vol. 10, July 1989, p. 1271-1276. refs

Four different supervised classification schemes, including minimum distance, decision tree, maximum likelihood, and a modified minimum distance classifier (the 'deviant distance' algorithm), were applied to Landsat Thematic Mapper imagery. They were compared in terms of speed of computation and classification accuracy. The processing time required by each classifier was noted, and the accuracy of each was calculated from contingency tables. Modal filters (3 x 3 and 9 x 9) were then applied to the classified images, and the processing times and classification accuracies were compared. In this empirical study it was found that, although the maximum likelihood algorithm provided the most accurate classification, the use of a faster algorithm, such as minimum distance followed by the application of a modal filter, could provide classifications of similar accuracy in less than the time taken by the supervised maximum likelihood algorithm. Author

A89-50803*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THRESHOLDS FOR THE PERCEPTION OF WHOLE-BODY LINEAR SINUSOIDAL MOTION IN THE HORIZONTAL PLANE

ROBERT W. MAH, LAURENCE R. YOUNG, CHARLES R. STEELE, and EARL D. SCHUBERT (NASA, Ames Research Center, Moffett Field; Stanford University, CA; MIT, Cambridge, MA) AIAA Flight Simulation Technologies Conference and Exhibit, Boston, MA, Aug. 14-16, 1989. 21 p.

(AIAA PAPER 89-3273)

An improved linear sled has been developed to provide precise motion stimuli without generating perceptible extraneous motion cues (a noiseless environment). A modified adaptive forced-choice method was employed to determine perceptual thresholds to whole-body linear sinusoidal motion in 25 subjects. Thresholds for the detection of movement in the horizontal plane were found to be lower than those reported previously. At frequencies of 0.2 to 0.5 Hz, thresholds were shown to be independent of frequency, while at frequencies of 1.0 to 3.0 Hz, thresholds showed a decreasing sensitivity with increasing frequency, indicating that the perceptual process is not sensitive to the rate change of acceleration of the motion stimulus. The results suggest that the perception of motion behaves as an integrating accelerometer with a bandwidth of at least 3 Hz. R.R.

N89-27338# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

HUMAN PERFORMANCE ASSESSMENT METHODS

May 1989. 70 p. Prepared for a Lecture Series, Downsview, Ontario, 5-6 Jun. 1989; Soesterberg, Netherlands, 12-13 Jun. 1989; and Rome (Italy), 15-16 Jun. 1989

(AGARD-AG-308; ISBN-92-835-0510-7; AD-A211106) Avail: NTIS HC A04/MF A01

The results are presented of the second phase of AGARD Aerospace Medical Panel Working Group 12 on Human Performance Assessment Methods. The major goal of WG 12 was to develop the Standardized Tests for Research on Environmental Stressors or STRES Battery, satisfying conventional psychometric criteria such as reliability, validity and sensitivity for which an extensive data base may now be compiled among the NATO nations. The protocol for the 7 selected tests is presented. AGARDograph 308 also serves as the Lecture Series Notes for AGARD Aerospace Medical Panel Lecture Series 163, Human Performance Assessment Methods. Author

N89-27339# National Inst. for Occupational Safety and Health, Morgantown, WV. Div. of Industrial Engineering.

A MODEL OF HUMAN REACTION TIME TO DANGEROUS ROBOT ARM MOVEMENTS

MARTIN G. HELANDER, MARK H. KARWAN (State Univ. of New York at Buffalo, Amherst.), and JOHN ETHERTON 1989 7 p (PB89-186522) Avail: NTIS HC A02/MF A01 CSCI 05/9

A model was presented of human reaction time and emergency behavior in the presence of a hazard caused by the use of a robot. The total reaction time was the sum of three elements: perception, decision making and motor response. The perceptual system must detect that the robot is moving and recognize this movement as potentially dangerous. The decision making involves whether to push the emergency stop on the teach pendant. The moving hand to the emergency stop would be accomplished by commands from the motor processor. Each of these elements was modeled using concepts such as perceptual discriminability and single detection theory. Finally the results of an experiment were presented where the relationships of the customer and the contractor, their characteristics, individual instruments for the configuration and securing of relationships and appropriate forms of contract are examined. The organizational/legal structure of collaboration, the planning of the fulfillment of the work tasks and the configuration of firms' information and control mechanisms in the project-related technology transfer with their interconnections and partners are discussed. GRA

NP9-27340# Army Research Inst. of Environmental Medicine, Natick, MA.

PSYCHOLOGICAL ATTRIBUTES, COPING STRATEGIES AND OTHER FACTORS ASSOCIATED WITH ULTRAMARATHON PERFORMANCE

W. J. THARION, A. L. TERRY, D. J. MCMENEMY, T. M. RAUCH, B. L. SHUKITT, E. GALLEGO, and L. GOWENLOCK Jan. 1989 106 p

(Contract DA PROJ. 3A1-61101-A-91C) (AD-A208300; USARIEM-T-8/89) Avail: NTIS HC A06/MF A01 CSCI 05/8

Mood states, symptomatology, coping strategies and training characteristics associated with running an ultramarathon were examined to explain racing performance and assess psychological health state. A total of 117 subjects were surveyed in 2 races (50-mile and 100-mile). Mood states and symptomatology were examined via a time-series approach with subjects queried pre, post, 1 week post, 1 month post, and 3 months postrun. Tension was found to be significantly greater prerun when compared to other administrations. Vigor was found to be significantly lower immediately postrun compared to the other administrations, whereas fatigue was found to be greater immediately postrun. Confusion was greater immediately postrun but had returned to prerace levels by 1 month postrun. Casualties were less fatigued and more depressed immediately postrun than were survivors. Additionally, survivors were found to be in better physical condition than casualties. The survivors weighed less, had been running for a longer period of time, ran more miles per week and ran at a faster training pace. Coping strategies were found to have an effect on performance. It appears that individuals who partition the race into segments fare better than those who do not. Finally, age, expected finish time and training pace are the best predictors for one's finish time in a 50-mile ultramarathon. GRA

MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

A89-48155*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, TX.

PLAID AS A MAINTAINABILITY TOOL

BARBARA J. WOOLFORD, LINDA S. ORR, and FRANCES E. MOUNT (NASA, Johnson Space Center, Houston, TX) AIAA and NASA, Symposium on the Maintainability of Aerospace Systems, Anaheim, CA, Jul. 26, 27, 1989. 11 p. (AIAA PAPER 89-5044)

PLAID is a computer-aided design tool for human factors engineering which has been used successfully in the Space Shuttle program and for design analysis of Space Station Freedom. PLAID capability includes analysis of visual fields of view, of the ability to reach a specified point, and of spatial conflicts. It enables the creation of animations which depict whole sequences of motions of astronauts and equipment. The PLAID graphics capability is described and its application to man-systems integration is briefly examined. The use of PLAID for maintainability is addressed, and future plans for PLAID are discussed. C.D.

A89-48276

SPACE SLED - A DEVICE FOR THE INVESTIGATION OF THE PHYSIOLOGICAL EFFECTS OF WEIGHTLESSNESS

A. J. BENSON (RAF, Institute of Aviation Medicine, Farnborough, England) and N. A. J. HARRY (Seminar on Engineering Aerospace Equipment, Birmingham, England, Oct. 29, 1987) Institution of Mechanical Engineers, Proceedings, Part G - Journal of Aerospace Engineering (ISSN 0954-4100), vol. 203, no. G1, 1989, p. 1-10. refs

Space Sled is a device for providing controlled linear acceleration stimuli in the microgravity environment of orbital flight. The scientific objectives of the experiments which used Space Sled on the D-1 Spacelab mission were to study aspects of otolith organ (that is, that part of the inner ear which transduces linear accelerations) function and adaptation in weightlessness. The seat accommodating the test subject can be mounted on the carriage in any of three orthogonal positions. The carriage is coupled by a flexible steel cable to a servo-controlled electric motor which is capable of producing a peak acceleration of 2 m/s² and peak velocity of 2.4 m/s. Mechanical structures providing carriage guidance, Sled/Spacelab interfaces, carriage latching, motor mounting and cable tensioning are detailed. Author

A89-48569*# Booz-Allen and Hamilton, Inc., Reston, VA. **IMPACT OF WATER INTEGRATION ON SPACE STATION FREEDOM PROPELLANT AVAILABILITY**

GEORGE R. SCHMIDT (Booz, Allen and Hamilton, Inc., Reston, VA) Journal of Spacecraft and Rockets (ISSN 0022-4650), vol. 26, July-Aug. 1989, p. 259-265. Previously cited in issue 20, p. 3275, Accession no. A87-45259. refs (Contract NAS8-36526)

A89-49010

CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEMS (CELSS) IN HIGH PRESSURE ENVIRONMENTS

B. G. THOMPSON (Alberta Research Council, Dept. of Biotechnology, Edmonton, Canada) Acta Astronautica (ISSN 0094-5765), vol. 19, May 1989, p. 463-465. refs

The question of whether a CELSS containing land plants and operating at environmental ambient pressures could be used in the high pressure environments of future space habitats is addressed. A pressure tank apparatus was used to determine the effects of elevated pressure on the germination, seed outgrowth, and biomass incorporation by photosynthesis of alfalfa, corn,

tomatoes, carrots, peas, *Arabidopsis thaliana*, and common dandelion. Although these plants were able to grow from seeds through the various phases of the growth cycle at 10 bar pressure, in some of the species, the stages were shown to be inhibited to some extent by high pressure. R.R.

A89-50064#

AERODYNAMIC FORCES ON FLIGHT CREW HELMETS

TIMOTHY A. SESTAK (U.S. Navy, Naval Air Development Center, Warminster, PA), RICHARD M. HOWARD, and CHESTER A. HEARD (U.S. Naval Postgraduate School, Monterey, CA) *Journal of Aircraft* (ISSN 0021-8669), vol. 26, Sept. 1989, p. 847-853. Previously cited in issue 16, p. 2696, Accession no. A88-40715. refs

A89-50454* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

A DESIGN FRAMEWORK FOR TELEOPERATORS WITH KINESTHETIC FEEDBACK

BLAKE HANNAFORD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) *IEEE Transactions on Robotics and Automation* (ISSN 1042-296X), vol. 5, Aug. 1989, p. 426-434. refs

The application of a hybrid two-port model to teleoperators with force and velocity sensing at the master and slave is presented. The interfaces between human operator and master, and between environment and slave, are ports through which the teleoperator is designed to exchange energy between the operator and the environment. By computing or measuring the input-output properties of this two-port network, the hybrid two-port model of an actual or simulated teleoperator system can be obtained. It is shown that the hybrid model (as opposed to other two-port forms) leads to an intuitive representation of ideal teleoperator performance and applies to several teleoperator architectures. Thus measured values of the h matrix or values computed from a simulation can be used to compare performance with the ideal. The frequency-dependent h matrix is computed from a detailed SPICE model of an actual system, and the method is applied to a proposed architecture. I.E.

N89-27341# Technology, Inc., San Antonio, TX. Life Sciences Div.

RESEARCH AND DEVELOPMENT OF ANTI-G LIFE SUPPORT SYSTEMS. PART 4: ENGINEERING TEST AND EVALUATION OF SIX ANTI-G VALVES Final Report, 1 Apr. 1981 - 31 Jul. 1985

LARRY J. MEEKER (School of Aerospace Medicine, Brooks AFB, TX.), ARNOLD G. KRUEGER, PAUL E. LOVE, EMILY M. GAUSE, and ROBERT W. KRUTZ Aug. 1988 118 p (Contract F33615-81-C-0600) (AD-A206996; USAFSAM-TR-86-36-PT-4) Avail: NTIS HC A06/MF A01 CSCL 23/5

Six anti-G valves (i.e., valves designed to rapidly deliver output pressures proportional to + Gz forces acting upon valve control elements) were evaluated for performance under conditions simulating the spectrum of Gz-onset conditions likely to be encountered by pilots of current U.S. Air Force high-performance aircraft. This Engineering Test and Evaluation Task was conducted on-site at Brooks Air Force Base, Texas, using the School of Aerospace Medicine (USAFSAM) human centrifuge facility. One objective was validation of uniform testing procedures for evaluation of anti-G valves under controlled conditions of: acceleration, source pressure, valve angles, and simulated anti-G suit volumes. A second objective was measurement of actual dynamic performance of the standard ALAR High-flow Ready-pressure; ALAR High-flow; Garrett Electronic/Pneumatic; Hymatic VAG-110-022; and AAMRL Electropneumatic (Bang Bang). The battery of test conditions employed was divided into three phases: Phase 1 - Maximum Flow Capacity Testing; Phase 2 - Dynamic Response Testing; and Phase 3 - Complex Dynamic Response Testing. Results of testing under all conditions are presented for each valve and the performance characteristics of all six valves are compared. GRA

N89-27342# Analytics, Inc., Willow Grove, PA.

HUMAN OPERATOR SIMULATOR (HOS) 4 PROGRAMMER'S GUIDE Final Report, 1987 - 1988

REGINA HARRIS, JONATHAN KAPLAN, CHRISTOPHER BARE, HELENE LAVECCHIA, and LORNA ROSS Jan. 1989 186 p (Contract F33615 86 C-0019) (AD-A207241; ARI-RP-89-06) Avail: NTIS HC A09/MF A01 CSCL 23/2

This report is a guide to maintaining and updating the source code for the Human Operator Simulator (HOS) 4, which was developed to aid in the design and evaluation of interfaces between operators or maintainers and weapon system hardware and software. HOS 4 creates simulations of manned systems on an IBM-AT PC or compatible. It does this by using micromodels of basic human processes to produce both system and human performance estimates. HOS 4 also includes a mechanism to aid in the creation of new micromodels. GRA

N89-27343# Foersvarets Forskingsanstalt, Stockholm (Sweden). Dept. of Human Studies.

FULL COVERAGE ANTI-G-SUIT AND BALANCED PRESSURE BREATHING

ULF BALDIN, GUNNAR DAHLBAECK, and LARS-ERIK LARSSON Feb. 1989 24 p (PB89-174635; FOA-C-50065-5.1; ISSN-0347-7665) Avail: NTIS HC A03/MF A01 CSCL 05/8

A full coverage anti-G-suit (FCAGS) was compared to a normal anti-G-suit (NAGS) in 9 fighter pilots. The G-tolerance was tested during gradual and rapid onset runs up to 9 G and during simulated aerial combat maneuvers in a human centrifuge. In 35 percent of the tests the subjects succeeded in reaching 9 G without straining maneuvers with FCAGS in comparison to only 12 percent with NAGS, and succeeded in staying there for 5 s in 18 percent and 0 percent of the tests, respectively. With rapid onset runs with straining maneuvers, 2 cases of G-induced loss of consciousness (GLOC) occurred with NAGS. The FCAGS was similarly tested up to 9 G in 9 subjects with and without balanced positive pressure breathing (BPPB). No GLOC occurred. Without straining maneuvers the subjects succeeded in reaching 9 G in 94 percent of the tests with BPPB in comparison to only 59 percent without BPPB and in staying at 9 G for 10 s in 82 percent and 18 percent of the tests, respectively. FCAGS gives substantial G-protection, especially when combined with BPPB. GRA

N89-27344*# National Academy of Sciences - National Research Council, Washington, DC. Committee on Human Factors.

ERGONOMIC MODELS OF ANTHROPOMETRY, HUMAN BIOMECHANICS AND OPERATOR-EQUIPMENT INTERFACES

1 ARL H. E. KROEMER, ed., STOVER H. SNOOK, ed., SUSAN K. MEADOWS, ed., and STANLEY DEUTSCH, ed. 1988 114 p Proceedings of a Workshop held in Washington, DC, 17-18 Jun. 1985 Sponsored in part by AFOSR, Washington, DC; Army Research Inst. for the Behavioral and Social Sciences, Arlington, VA; NASA, Washington, DC and NSF, Washington, DC (Contract N00014-85-G-0093) (NASA-CR-185720; NAS 1.26:185720; PB89-175491) Avail: NTIS HC A06/MF A01 CSCL 06/16

The Committee on Human Factors was established in October 1980 by the Commission on Behavioral and Social Sciences and Education of the National Research Council. The committee is sponsored by the Office of Naval Research, the Air Force Office of Scientific Research, the Army Research Institute for the Behavioral and Social Sciences, the National Aeronautics and Space Administration, and the National Science Foundation. The workshop discussed the following: anthropometric models; biomechanical models; human-machine interface models; and research recommendations. A 17-page bibliography is included. Author

N89-27345# National Academy of Sciences - National Research Council, Washington, DC. Committee on Toxicology.

SUBMARINE AIR QUALITY: MONITORING THE AIR IN SUBMARINES. HEALTH EFFECTS IN DIVERS OF BREATHING SUBMARINE AIR UNDER HYPERBARIC CONDITIONS Final Report

Dec. 1988 160 p

(Contract. AMD17-86-C-6151)

(PB89-174213) Avail: NTIS HC A08/MF A01 CSCL 05/8

The report is an assessment of the quality of the air in the enclosed environment of a nuclear submarine. Part 1 is a review of the analytic techniques used in monitoring submarine contaminants, a study of possible alternate monitoring methods, and recommendations on which compounds would be most useful to monitor. Part 2 is a review of the possible health effects in divers of breathing commonly encountered airborne contaminants at pressures of up to 6 atmospheres, considering possible interactions of substances encountered as mixtures. Recommendations include the curtailment of smoking, the possible elimination of deep-fat fryers, the use of nontoxic paints, an increased monitoring capability, the establishment of toxic categories for chemicals, a review of the methods of instruction of personnel regarding air control equipment, and increased communication with the British Royal Navy regarding the monitoring of air contaminants. Recommendations for divers' air include the monitoring of CO₂ and particulates with their removal if necessary, and the study of animals or humans exposed to elevated levels of CO₂. Also recommended is physiological research on the interaction of cold, extreme exercise, and breathing compressed gases.

Author

N89-27346*# California Univ., Davis. Plant Growth Lab.
EFFICIENCY OF N USE BY WHEAT AS A FUNCTION OF INFLUX AND EFFLUX OF NO SUB 3

R. C. HUFFAKER, M. ASLAM, and M. R. WARD Jul. 1989 25 p

(Contract NCC2-99)

(NASA-CR-177534; NAS 1.26:177534) Avail: NTIS HC A03/MF A01 CSCL 06/11

Since N assimilation is one of the most costly functions of a plant, its efflux before assimilation results in a serious energy cost and loss in efficiency which could decrease yields. Efficient crop production is critical to the Controlled Ecological Life-Support System (CELSS). The objective is to determine the extent of efflux of the N species NO₃(-), NH₄(+), NO₂(-), and urea after uptake, and possible means of regulation. It was found that NO₃(-) efflux became serious as its substrate level increased. Efflux/Influx (E/I) of 3NO₃(-) was greater in darkness (35 pct) than in light (14 pct) and the ratio greatly increased with increased substrate NO₃(-), (up to 45 pct at 10 mM). It seems advantageous to use the lowest possible nutrient concentration of NO₃(-). The feasibility of using ClO₃(-) as a trapping agent (competitive inhibitor of NO₃(-) uptake) for effluxed NO₃(-) was assessed and its toxicity determined.

Author

N89-27347# Army Research Inst. of Environmental Medicine, Natick, MA. Exercise Physiology Div.

THE EFFECTS OF ARMS AND COUNTERMOVEMENT ON VERTICAL JUMPING Scientific Paper

EVERETT A. HARMAN, MICHAEL T. ROSENSTEIN, PETER N. FRYKMAN, and RICHARD ROSENSTEIN 28 Apr. 1989 29 p (AD-A208298) Avail: NTIS HC A03/MF A01 CSCL 06/10

Countermovement (C) and arm-swing (A) characterize most jumping. For determination of their effects and interaction, 18 males jumped for maximal height from a force platform four ways: C,A; C, no A; no C, A; no C, no A. For all jumps, vertical velocity peaked 0.03 sec before, and dropped 6 to 7 percent by takeoff. Peak positive power averaged over 3,000 W, and occurred about 0.07 s before takeoff, shortly after maximum vertical ground reaction force (VGRF) and just before peak vertical velocity. Both C and A significantly (p less than 0.05) improved jump height, but A's effect was greater, enhancing both height of the total body center of mass (TBCM) at takeoff and post-takeoff TBCM rise. C only

affected the latter. Use of A resulted in less unweighting and slower descent of the TBCM during C, higher TBCM position at the bottom of C, higher peak VGRF, higher peak positive power, and lower negative power. C increased pretakeoff jump duration by 71 to 76 percent, increased average positive power, and resulted in large positive and negative impulses. Correlation of peak power with post-takeoff jump height was 0.88. Body weight and post-takeoff jump height effectively predicted peak power (r=0.94). The results lend insight into which jumping techniques are most appropriate for given sports situations.

GRA

N89-28211*# Good Samaritan Hospital and Medical Center, Portland, OR. Dept. of Neuro-otology.

AGE-RELATED CHANGES IN HUMAN VESTIBULO-OCULAR REFLEXES: SINUSOIDAL ROTATION AND CALORIC TESTS

R. J. PETERKA, F. O. BLACK, and M. B. SCHOENHOFF 1989 15 p

(Contract NAG9-117)

(NASA-CR-185857; NAS 1.26:185857) Avail: NTIS HC A03/MF A01 CSCL 05/8

The dynamic response properties of horizontal vestibulo-ocular reflex (VOR) were characterized in 216 human subjects ranging in age from 7 to 81 years. The object of this cross-sectional study was to determine the effects of aging on VOR dynamics, and to identify the distributions of parameters which describe VOR responses to caloric and to sinusoidal rotational stimuli in a putatively normal population. Caloric test parameters showed no consistent trend with age. Rotation test parameters showed declining response amplitude and slightly less compensatory response phase with increasing age. The magnitudes of these changes were not large relative to the variability within the population. The age-related trends in VOR were not consistent with the anatomic changes in the periphery reported by others which showed an increasing rate of peripheral hair cell and nerve fiber loss in subjects over 55 years. The poor correlation between physiological and anatomical data suggest that adaptive mechanisms in the central nervous system are important in maintaining the VOR.

Author

N89-28212*# Good Samaritan Hospital and Medical Center, Portland, OR. Dept. of Neuro-otology.

AGE-RELATED CHANGES IN HUMAN POSTURE CONTROL: SENSORY ORGANIZATION TESTS

R. J. PETERKA and F. O. BLACK 1989 17 p

(Contract NAG9-117)

(NASA-CR-185858; NAS 1.26:185858) Avail: NTIS HC A03/MF A01 CSCL 05/8

Postural control was measured in 214 human subjects ranging in age from 7 to 81 years. Sensory organization tests measured the magnitude of anterior-posterior body sway during six 21 s trials in which visual and somatosensory orientation cues were altered (by rotating the visual surround and support surface in proportion to the subject's sway) or vision eliminated (eyes closed) in various combinations. No age-related increase in postural sway was found for subjects standing on a fixed support surface with eyes open or closed. However, age-related increases in sway were found for conditions involving altered visual or somatosensory cues. Subjects older than about 55 years showed the largest sway increases. Subjects younger than about 15 years were also sensitive to alteration of sensory cues. On average, the older subjects were more affected by altered visual cues whereas younger subjects had more difficulty with altered somatosensory cues.

Author

N89-28213*# Good Samaritan Hospital and Medical Center, Portland, OR. Dept. of Neuro-otology.

AGE-RELATED CHANGES IN HUMAN VESTIBULO-OCULAR AND OPTOKINETIC REFLEXES: PSEUDORANDOM ROTATION TESTS

R. J. PETERKA, F. O. BLACK, and M. B. SCHOENHOFF 1989 16 p

(Contract NAG9-117)

(NASA-CR-185856; NAS 1.26:185856) Avail: NTIS HC A03/MF A01 CSCL 05/8

The dynamic response properties of horizontal vestibulo-ocular reflex (VOR) and optokinetic reflex (OKR) were characterized in 216 human subjects ranging in age from 7 to 81 years. The object of this cross-sectional study was to determine the effects of aging on VOR and OKR reflex dynamics, and to identify the distributions of parameters which describe VOR and OKR responses to pseudorandom stimuli in a putatively normal population. In general, VOR and OKR response parameters changed in a manner consistent with declining function with increasing age. For the VOR this was reflected in declining response amplitudes, although the magnitude of the decline was small relative to the variability of the data. For the OKR the lag time of the response, probably associated with the time required for visual information processing, increased linearly with age at a rate of about 1 ms per year.

Author

N89-28214# European Space Agency, Paris (France).
THIRD EUROPEAN SYMPOSIUM ON SPACE THERMAL CONTROL AND LIFE SUPPORT SYSTEMS

T. DUC GUYENNE, ed. and J. HUNT, ed. Dec. 1988 629 p
Symposium held in Noordwijk, Netherlands, 3-6 Oct. 1988
(ESA-SP-288; ISSN-0379-6566; ETN-89-95012) Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Environmental control and life support systems; heat transport systems; orbital systems thermal control; atmosphere management; EVA; analysis methods; satellite thermal control; liquid management and habitability; cryogenics; in-orbit performance and testing; thermal control technology; and reentry and thermal protection systems were discussed.

ESA

N89-28215*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, AL.

STATUS OF THE US SPACE STATION ECLSS AND INTERNAL TCS

R. HUMPHRIES, L. TURNER, J. REUTER, and D. PATTERSON
In ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 5-13 Dec. 1988
Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The space station environmental control and life support system (ECLSS) and internal thermal control system (ITCS) are outlined. The ECLSS is composed of six subsystem groups: the temperature humidity control, the atmosphere control and supply, the air revitalization, water reclamation and management, fecal waste management, and the fire detection and suppression subsystems. The ITCS consists of all WP01 elements of passive and active thermal measures. The ECLSS and ITCS provide services for the permanently orbiting pressurized modules as well as the pressurized and unpressurized logistics carriers. All internal cooling of the permanent orbital elements are provided via internal active fluid loops within the elements utilizing water as the transport media. Cabin and equipment cooling are provided by forced air flow and coldplate heat sinks. An active cooling loop is provided in the laboratory module to accommodate experiments and other payloads. Coatings and insulation are used in conjunction with the active components to passively limit heat losses/gains. The most challenging ECLSS new technology issues relate to oxygen and water recovery. Closure of the oxygen loop requires the use of regenerative CO₂ removal and concentration techniques. CO₂ reduction to convert the CO₂ to water with a waste by-product, and the electrolysis of water to produce breathing oxygen for water recovery.

ESA

N89-28216*# Entwicklungsring Nord, Bremen (Germany, F.R.).
SYSTEM ASPECTS OF COLUMBUS THERMAL CONTROL AND LIFE SUPPORT

U. LAUX, B. BEHRENS, and R. LAWSON In ESA, Third European Symposium on Space Thermal Control and Life Support Systems

p 15-23 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Thermal Control and Life Support Systems of the Columbus flight configurations, the Attached Pressurized Module (APM), the Man Tended Free Flyer (MTFF) and the Polar Platform (PPF) are described. The overall APM and MTFF Environmental Control and Life Support System (ECLSS) is strongly affected by the interfaces to the International Space Station (ISS) and Hermes. It is proposed to centralize particular ECLSS functions of both the APM and MTFF for reasons of cost, mass, power, and complexity reduction and to operate the MTFF-ECLSS in a power saving mode during the free flying phase. Rejection of the APM generated heat is performed totally by the ISS, whereas the MTFF Thermal Control is fully autonomous in the free flying and Hermes servicing phase. The preferred MTFF orientation, which is driven by the very stringent microgravity requirement, is in conflict with the heat rejection capabilities of the TCS.

ESA

N89-28217# Aerospatiale Usines de Toulouse (France).

THE HERMES SPACEPLANE PROGRAM: STATUS REPORT ON THE THERMAL CONTROL, ENVIRONMENT CONTROL AND LIFE SUPPORT ACTIVITIES

H. LACAZE, P. BISIAUX, and C. RODIERE In ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 25-36 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The status of the Hermes, the thermal protection subsystem, thermal control subsystem, and environmental control and life support subsystem is outlined. Each one contributes to the thermal control of some part of the vehicle and is therefore influenced by the two others. Due to severe constraints coming from the launcher performances, the Hermes mass budget is critical and renders necessary elaborate design studies and use of advanced techniques for most component parts.

ESA

N89-28218# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

EUROPEAN LIFE SUPPORT SYSTEMS FOR SPACE APPLICATIONS

H. PREISS In ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 39-44 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The environmental control and life support systems (ECLSS) for Columbus and Hermes are described, and the ECLSS requirements for European missions to Mars, the Moon, and an LEO station are outlined. It is argued that to meet these demands, international cooperation is necessary.

ESA

N89-28219# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS FOR PRESSURIZED MODULES: FROM SPACELAB TO COLUMBUS

K.-O. HIENERWADEL and G. KRING In ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 45-50 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The Columbus environmental control and life support system (ECLSS) is compared with the Spacelab ECLSS. The individual Columbus ECLSS equipment characteristics are identified, stating whether they are identical, modified, and advanced or completely new compared to the Spacelab capabilities. Although the basic ECLSS functions of Columbus are similar to those of Spacelab there are considerable differences in design and performance between the two systems. These differences are mainly caused by two factors. The first one is the mission duration characterized by the in orbit life time of the module and the uninterrupted attendance of one crew before change of shift. The second one

is the required full automatic operation capability caused by the 180 days free flying and unmanned period of the Man-Tended Free Flyer.
ESA

N89-28220# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

THE DEFINITION STATUS OF THE ENVIRONMENTAL CONTROL AND LIFE SUPPORT SUBSYSTEMS FOR HERMES

R. SCHAEFER *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 51-55 Dec. 1988
Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The status of the Hermes environmental control and life support system (ECLSS) and the main differences compared with the Spacelab ECLSS are outlined. Requirements development from Phase A (6 men, 2 volumes) to Phase B (3 men, 3 volumes) and the relevant configurations are described. The atmosphere pressure control section; air conditioning section; liquid management section; food galley management section; hygiene and solid waste management section; and monitoring, control, and power management section are described.
ESA

N89-28221# Nelson Space Services Ltd., London (England).

PHYSICO-CHEMICAL ATMOSPHERE REVITALISATION: THE QUALITATIVE AND QUANTITATIVE SELECTION OF REGENERATIVE DESIGNS

R. C. HUNTENBACH, A. R. KAISER, J. D. RADFORD, and R. A. BINOT (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 57-64 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The systems engineering needs of regenerative physico-chemical atmosphere revitalization is discussed from the qualitative point of view, and a procedure that can be used to quantify the prospective merits of competing designs at an early stage in their development cycle is described. This procedure involves the preparation of energy and multicomponent material balances, the derivation of weight penalties for various power generation/supply and heat rejection technologies, the calculation of equivalent weights versus duration of mission and the use of spreadsheets to analyze the sensitivity of results when input data such as the weight of flight qualified equipment is subject to uncertainty. The methodology can be applied to other systems including water management and future biological options on manned space missions.
ESA

N89-28222# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

MELISSA: A MICRO-ORGANISMS-BASED MODEL FOR CELSS DEVELOPMENT

M. MERGEAY, W. VERSTRAETE, G. DUBERTRET, M. LEFORT-TRAN, C. CHIPAUX, and R. A. BINOT (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 65-68 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The MELISSA was conceived as a microorganism based ecosystem, being a simplified, model of a future biological life support system for manned missions. The driving element is the reprocessing of edible biomass from waste, CO₂, and minerals with the direct use of sunlight as a source of energy for biological photosynthesis. A four compartments ecosystem is selected allowing the closure of the material loop around a central food and O₂ reprocessing compartment by the growth of the filamentous cyanobacterium SPIRULINA. Nitrates, CO₂, and minerals required by SPIRULINA are produced by the other microbial compartments, namely an anaerobic digestion system and a nitrifying compartment. The anaerobic digestion system includes a thermophilic solubilization and fermentation compartment (CLOSTRIDIA)

followed by a second light dependent compartment, colonized by RHODOBACTER, removing the soluble organics (mainly fatty acids) and leaving the minerals requested by SPIRULINA, and producing a biomass of high food value. Nitrification of ammonium from the anaerobic step to nitrate for SPIRULINA, is performed by NITROBACTERIA, with a very low biomass production, in the fourth compartment. For a consumer added to the loop, MELISSA ensures food and oxygen recycling through complete carbon, nitrogen, sulfur and minerals cycles, driven in axenic conditions by genetically well-known, nonpathogenic strains.
ESA

N89-28223# MATRA Espace, Paris-Velizy (France).

POSSIBLE USE OF A GAS MONITORING SYSTEM IN SPACE RESPIROMETRY STUDIES

C. LASSEUR, C. CHIPAUX, M. ANDRE, F. X. COTE, and J. MASSIMINO (Commissariat a l'Energie Atomique, Saint-Paul-les-Durance, France) *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 69-72 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The C23A system (automatic culture chambers in artificial atmosphere) was used in respiratory studies on a small animal, Triturus Walt l.l. The multiplexed analyzers allow use of the same analyzer for several different applications, e.g., respirometry, or atmosphere. This method permits to decrease weight and reduce the number of gas calibrations. Similarly the design of the computing system anticipates the full separation between automation in space and control-command on ground.
ESA

N89-28224# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

TWO-PHASE HEAT TRANSPORT SYSTEMS: CRITICAL COMPONENTS

H. KREEB and R. SIEPMANN *In* ESA, Third European Symposium on Space Thermal Control and Life Support System p 75-82 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Within the preparatory support technology program for COLUMBUS a mechanically pumped two-phase heat transport system is developed. A preparatory study recommended system based on a parallel arrangement of evaporator cold plates and heat exchangers, condenser units, and a conventional mechanical pump. Important characteristics of this system include the controlled flooding of the condensers with liquid to achieve temperature control and the ability to use the evaporators also as condensers to permit heat load sharing between payload elements. In order to meet Columbus-requirements the system is specified to work at a maximum heat load of 10 to 20 kW at a nominal temperature of 20 C. The working medium is freon R 114. The design of the overall system, the breadboard development of the critical components, and the planned test-bed verification are outlined.
ESA

N89-28225# Societe Anonyme Belge de Constructions Aeronautiques, Brussels.

FEASIBILITY DEMONSTRATION MODEL OF A CAPILLARY PUMPING LOOP

R. S. BHATTI, S. VANOOST, and C. J. SAVAGE (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 83-88 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The general objectives, the design concept, and the potential performances of the two-phase capillary pumping loop (CPL) as a heat transportation system are reviewed. Results obtained on the first breadboard CPL model are reported with comparison of predicted against tested performances.
ESA

N89-28226# Entwicklungsring Nord, Bremen (Germany, F.R.).

DESIGN AND TEST OF A TWO-PHASE COLDPLATE

R. MUELLER /In ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 89-95 Dec. 1988
 Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The design and the results of a performance test for a two phase cold plate are presented. The cold plate consists of 7 parallel aluminum evaporator tubes and a 50 x 50 cm mounting plate. The evaporator tubes are equipped with capillary circumferential grooves and an internal structure to separate liquid and vapor. The cold plate is suitable for application in mechanically, as well as capillary pumped loops. In the test the heat transport limit of the evaporator tubes, i.e., the dryout of their circumferential grooves, was evaluated. The test was conducted in the mechanically pumped mode using ammonia as a working fluid. It demonstrates the feasibility of the selected design of the cold plate evaporator tubes. Heat flux limits ranging from 2.4 and 10.7 W/sq cm and heat transfer coefficients between 0.14 and 1.35 W/sq cm-K were measured for the different evaporator tubes. ESA

N89-28227# Minelectrotechprom, Moscow (USSR).

NON-CONDENSABLE GAS EFFECTS ON THE LOW-TEMPERATURE HEAT PIPE CHARACTERISTICS

M. D. PARFENTIEV /In ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 97-101 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Results of studies on noncondensable gas (NCG) distribution in condensation zones of low temperature heat pipes (LTHP) and estimates of its effect on distribution of both localized heat flows and localized heat-exchange coefficients as well as LTHP was temperature profile in condensation zone are described. Based on visual studies on vapor-gas mixture distribution in LTHP condensation zone, a NCG distribution model is proposed which considers distribution irregularities both in axial and radial directions. Using the accepted NCG distribution model as the base, the heat balance equation for a condenser wall component which considers variable thermal resistance of a NCG layer was obtained. ESA

N89-28228# Tokyo Univ., Sagamihara (Japan).

MICRO-FLUID DYNAMICAL ANALYSIS OF EVAPORATING FLOWS IN HEAT PIPES

K. OSHIMA and N. IZUTSU /In ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 103-108 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Heat pipe systems utilizing phase changing heat transfer concepts are introduced, including micro heat pipes, a separate type heat pipe heat exchanger, and heat pipe turbines. Inside these heat pipes, contrary to the conventional thermosyphon, evaporation and condensation processes are heavily influenced by the surface tension effect. This effect is also dominant in heat pipes operating under microgravity in space. Similarity parameters concerning these phenomena are discussed. Laboratory experiments as well as numerical simulations of the flows relating to evaporative heat transfer were carried out. It is found that heat transfer by the evaporation process is decreased in such conditions. ESA

N89-28229# Minelectrotechprom, Moscow (USSR).

EXPRESS-METHOD INVESTIGATION AND ITS APPLICATION FOR HEAT PIPE QUALITY CONTROL

A. D. LOBANOV and A. A. PARENTIEVA /In ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 109-112 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Results of studies and application of a heat pipe quality control method applicable in the pipe series production (and introduced)

into the heat pipe production process and on installing the heat pipes on cooled and controlled temperature instruments and equipment, with no pipes disconnected from these instruments, are described. A heat short time action (heat flux density ranges from unities to tens of W/sq m and time interval, from unities to tens of seconds) is applied upon an envelope of a working fluid filled and sealed heat pipe locally, that is on its small section (an area of 1 sq m) and the pipe envelope temperature increase at the heat short time action input section is registered during its effect time or a shorter period. It is possible to determine a heat pipe parameter controlled by making comparison with an increase in temperature premeasured at a reference device subjected to a similar effect. The method is used to check working fluid availability in a heat pipe, to test noncondensable gas absence (or presence of its given amount) therein. The method markedly accelerates heat pipe rejection and improve quality control reliability (one heat pipe requires only 30 sec for its testing). ESA

N89-28230# National Aerospace Lab., Emmeloord (Netherlands). Space Div.

DEVELOPMENT OF A SENSOR FOR HIGH-QUALITY TWO-PHASE FLOW

A. A. M. DELIL and J. F. HEEMSKERK /In ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 113-123 Dec. 1988 Sponsored in part by the Netherlands Agency for Aerospace Programs
 Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Based on a tradeoff of quality monitoring concepts, a dedicated quality sensor for two phase mixtures was developed, based on the axial capacitance principle. Its theoretically demonstrated feasibility as quality and wetting sensor was experimentally confirmed by experiments using liquid layer simulating plastic sheets and annular air/liquid flow. Experiments in a two-phase freon test loop show the sensor to be an accurate, fast responding, sensitive instrument. It was accepted for further development as a component of the two-phase heat transport system developed by the European Space Agency. Performance figures, obtained by calibrations in a freon 114 loop, are given. Recommendations for future work and applications are indicated. ESA

N89-28237# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

REGENERATIVE CO₂-CONTROL

H. PREISS and H. FUNKE /In ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 177-183 Dec. 1988 Sponsored by the Bundesministerium fuer Forschung und Technologie, Bonn, Fed. Republic of Germany
 Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Technological work for a regenerative CO₂-control system, applicable for longterm space missions, especially the Columbus program, is described. Regenerative CO₂-control is required for this program, because the previous use of expendable chemical agents as applied for Spacelab leads to unacceptable mass and volume penalties. In regenerative CO₂-control, the adsorber material can accumulate and release CO₂ in a periodic way. However the regeneration process needs energy, which is not necessary for the expendables. Major design parameters, which allow the sizing and interface definition of a regenerative CO₂-control for an actual space application were derived. This is demonstrated by the successful operation of an advanced breadboard, where predicted and measured performance are in good agreement. Two adsorber materials were tested, showing adequate performance. The research material has better stability than the commercial product and is the favored material. ESA

N89-28238# Draegerwerk A.G., Luebeck (Germany, F.R.)

ELECTROCHEMICAL REMOVAL AND CONCENTRATION OF CO₂

S. HAUPT /In ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 185-186 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

It is argued that because electrochemical reactions can be performed with high power efficiencies, and because of the direct transfer of the removed CO₂ into hydrogen, the electrochemical method has advantages in comparison to other methods, when requirements such as power consumption, efficiency, mass and volume are concerned. An electrochemical assembly similar to a fuel cell can meet the requirements for CO₂ removal in space application. For the construction of an effective system for CO₂ removal and concentration, all electrode processes and transport mechanisms have to be studied in detail. Using ion selective membranes, the transport processes can be controlled effectively. ESA

N89-28239# Draegerwerk A.G., Luebeck (Germany, F.R.).
THE CATALYTIC OXIDIZER: DESCRIPTION AND FIRST RESULTS OF A BREADBOARD MODEL FOR A COMPONENT OF THE COLUMBUS ECLSS

K. AMMANN *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 187-192 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

A technological breadboard of a catalytic oxidizer system was designed to remove the low boiling point hydrocarbons, hydrogen, and carbon monoxide from a space station atmosphere. With respect to the necessary flow rate, CO turned out to be the design driver, while CH₄ (which needs a flow rate significantly lower than CO) is the design driver for the temperature required. For energy saving, a two catalyst system which consists of a high flow/low temperature catalyst for CO oxidation and a low flow/high temperature catalyst for the oxidation of methane, hydrogen and the other candidate contaminants was chosen. Results of performance tests including experiments with selected catalyst poisons are discussed. ESA

N89-28240# Nord-Micro Elektronik Feinmechanik G.m.b.H., Frankfurt (Germany, F.R.).
CONDENSING HEAT EXCHANGERS FOR EUROPEAN SPACECRAFT ECLSS

P. KUHN and F. PETTER *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 193-197 Dec. 1988 Sponsored by the Bundesministerium fuer Forschung und Technologie, Bonn, Fed. Republic of Germany and Aerospatiale, France

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Based on an earlier concept, a condensing heat exchanger type with lower complexity and reduced weight and volume compared with previous configurations was developed. Probe units with extremely low leakage were obtained both by careful selection of materials and processes and close control of manufacturing parameters. Hydrophilic coatings on the basis of borosilicate glass and polysilicate ceramic, providing wettable surfaces to the air passes and slurpers of condensing heat exchangers were developed. ESA

N89-28241# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
THE ATMOSPHERE PRESSURE CONTROL SECTION OF THE HERMES ECLSS

G. HAUSER *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 199-204 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The Atmosphere Pressure and Control Section (APCS) is part of the Hermes Environmental Control and Life Support Subsystem (ECLSS), which has to provide a safe and habitable environment for the crew. The APCS maintains the cabin total pressure and oxygen partial pressure in the specified limits, and supplies gas to several users, e.g., EVA suits, oxygen masks, docked MTFF. It

has the capability to restore the atmosphere after depressurization of the airlock at the end of EVA as well as after evacuation of the total habitable volume after fire/contamination. Calculated performance data are presented. The location of all APCS assemblies within the different Hermes volumes and conceptual details such as redundancy and safety provisions are shown. ESA

N89-28242# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.). Space Station Program Office.
COME TO FLIGHT RULES: RATIONALE ON ENVIRONMENTAL CONTROL AND LIFE SUPPORT SYSTEMS

H. BAUER *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 205-208 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Critical aspects of the Hermes-MTFF system flight rule definition are discussed. The most constraining life support system is the cabin pressure integrity, the O₂ and CO₂ concentration. It starts with an emergency landing requirement abort once around, or if it is worse with a transatlantic landing or even with a return to landing site. Loss of two H₂O loops within the air revitalization system requires also an abort once around. For all other failures a work-around solution according operational flight rules can be found. Failure in the flash evaporator system may not cause an emergency landing, but evaluating existing systems and relevant flight rules can keep the crew busy in solving the problems and to continue the flight with constraints. ESA

N89-28243# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
THE EUROPEAN SPACE SUIT SYSTEM

N. HERBER *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 211-219 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The European Space Suit System (ESSS) status is foreseen for servicing of various elements of space infrastructure within typical operational scenarios based on Hermes. As a result of different EVA studies the ESSS concept was defined and structured in three modules: the EVA Suit Enclosure Module, the EVA Life Support Module, and the EVA Information and Communication Module. The fourth equipment which has to be seen as a part of the Space Suit System as well, is the EVA Support and Verification Equipment responsible for suit accommodation, recharging, check out and the like. ESA

N89-28244# European Space Agency, European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
LIFE SUPPORT FOR EVA: THE EUROPEAN SYSTEM BASELINE

J. WITT, B. SVENSSON, and R. VAETH (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 221-226 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Based on earlier system studies the EVA Life Support Module (ELSM) was studied. A review of metabolic design factors set the performance limits of the ELSM. Various design solutions for the physical realization of the ELSM functions were studied and traded-off against each other. The design baseline for the ELSM established is presented. The further development of life support for EVA in Europe is timed for a first manned flight of Hermes in 1999. ESA

N89-28245# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
THERMAL MODELLING OF THE EVA-SUITED ASTRONAUT

L. SIMIONESCO and D. HORNET *In* ESA, Third European

Symposium on Space Thermal Control and Life Support Systems p 227-232 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

A computer thermal model which integrates the man-in-the-loop was developed in order to analyze the interactions between the human self-regulating thermal mechanisms and the behavior of the ELSS, water and gas heat transport loops. Because the human thermodynamic behavior is dependent on its own thermal status (metabolic activity and core temperature) and on its environment (gas constituents partial pressures and relevant temperatures) those variables had to be introduced into the conventional heat and mass transfer scheme. ESA

N89-28246# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

EVA AND HUMAN PHYSIOLOGY

B. SVENSSON, L. VOGT, and N. HERBER (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.G.) *In its* Third European Symposium on Space Thermal Control and Life Support Systems p 233-238 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The crew requirements for the European EVA space suit are divided into human safety, human physiology, and crew performance and productivity requirements. The human physiology requirements addresses areas like anthropometry, biomechanics, psychosensory performance and protection, atmosphere composition and pressure, metabolism, weightlessness effects and radiation. It is planned to perform validation of critical parameters by tests, e.g., the establishment of risk factors for decompression sickness. Considerations and test results of physiological parameters will be given to the ESA medical board, which will give recommendations on acceptable risk factors, maximum and minimum exposure levels, and comfort levels for the EVA crew members. ESA

N89-28247# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.G.).

ADVANCED MODULAR SOFTWARE DEVELOPMENT IN THERMAL ENGINEERING

R. BISANZ and F. ZILLY *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 241-248 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

A Concept for Simulation and Analysis of Space Systems (COSIMA) was developed utilizing advanced modular software engineering techniques and the software management system RSYST. Realizations in various disciplines and project applications demonstrated the advantages of this concept. The main components of COSIMA and its application to thermal radiation software development, and a materials data base are described. Help facilities are outlined. ESA

N89-28248# Fokker B.V., Amsterdam (Netherlands). Space and Systems Div.

LUMPING, A POWERFUL DESIGN TOOL FOR THERMAL CONTROL

W. KRUIDHOF *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 249-253 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Temperatures calculated for electronics boxes of the HIPPARCOS spacecraft with a so-called lumped thermal mathematical model (LTMM) and a comprehensive thermal mathematical model (CTMM) are compared. The temperatures predicted with the LTMM and the temperatures actually measured for the electronic boxes during the HIPPARCOS PFM test are also compared. It is demonstrated that the box temperatures as predicted with the LTMM can be correlated within a bandwidth of

+ or - 6 C with the CTMM (all boxes considered) and within a bandwidth of + or - 7 C with the PFM test results (only units of which temperature was monitored in PFM test considered). ESA

N89-28249# MATRA Espace, Toulouse (France).

IMPROVED RAY TRACING TECHNIQUE FOR RADIATIVE HEAT TRANSFER MODELLING

C. KOECK *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 255-260 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The implementation of an optimized ray-tracing technique in a thermal radiation software based on Monte-Carlo gave an efficient tool to compute radiative exchange factors and external heat fluxes. The software presents the advantages of the Monte-Carlo method: better physical modeling, simplicity of use, without its usual drawback: computer run time. As an indication, computation of view-factors within an enclosure of hundred surfaces can be 100 times faster than when using the double summation method of VWHEAT. Features such as surface specularly or transparency are accounted for in the simulation. ESA

N89-28250# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).

APPLICATION OF EXPERT SYSTEMS TO THE THERMAL CONFIGURATION OF GIOTTO

G. LIMOUZIN and R. J. WILSON *In its* Third European Symposium on Space Thermal Control and Life Support Systems p 261-266 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

An experimental expert system was developed to monitor and control the thermal subsystem of a spacecraft. Its aim was to demonstrate the feasibility of such a system to assist non-experts in managing the spacecraft's thermal behavior. Giotto was taken as the test case as its thermal control was performed by ground command during its flight towards comet Halley. A knowledge based expert system was constructed and its conception was made easy to use for non-computer specialists. Based on a rules production system, this mock up was written in PROLOG and was implemented on a VAX/750 minicomputer. ESA

N89-28262# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX

TEST RESULTS ON RE-USE OF RECLAIMED SHOWER WATER: SUMMARY

C. E. VEROSTKO, R. GARCIA, R. SAUER, A. T. LINTON, T. ELMS, and R. P. REYSA (Eoing Aerospace Co., Houston, TX.) *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 353-360 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars CSCL 05/B

A microgravity whole body shower (WBS) and waste water recovery systems (WWRS) were evaluated in three separate closed loop tests. Following a protocol similar to that anticipated for the U.S. Space Station, test subjects showered in a prototype whole body shower. The WWRS processes evaluated during the test series were phase change and reverse osmosis (RO). A preprototype Thermoelectric Integrated Hollow Fiber Membrane Evaporation Subsystem phase change process was used for the initial test with chemical pretreatment of the shower water waste input. The second and third tests concentrated on RO technologies. The second test evaluated a dynamic RO membrane consisting of zirconium oxide polyacrylic acid (ZOPA) membranes deposited on the interior diameter of 316L porous stainless steel tubes while the final test employed a thin semipermeable RO membrane deposited on the interior surface of polysulfone hollow fibers. All reclaimed water was post-treated for purity using ion exchange and granular activated carbon beds immediately followed by microbial control treatment using both heat and iodine. The test hardware, controls exercised for whole body showering, types of

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soaps evaluated, shower subject response to reclaimed water showering, and shower water collection and chemical pretreatment (if required) for microbial control are described. The WWRS recovered water performance and the effectiveness of the reclaimed water post-treatment techniques used for maintaining water purity and microorganism control are compared. Results on chemical and microbial impurity content of the water samples obtained from various locations in the shower water reuse system are summarized. ESA

N89-28263# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

THE LIQUID MANAGEMENT SECTION OF THE HERMES ECLSS

R. STRITTMATTER *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 361-366 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The equipment required and the processes used to provide the crew of Hermes with potable water and to collect waste liquids within the habitable area and the airlock are described. The treated water flowing steadily at 1.5 kg/hr in average from the fuel cells will be stored in double redundant tanks of 50 liters each while quality controlled and processed for multiple uses (drink/food preparation, washing, cooling purposes). Two tanks for the collection and temporary storage of waste liquids, provisions for overboard dumping of excess liquids and for transfer to and from docked modules (MTFF, Space Station) are foreseen. ESA

N89-28264# Österreichische Raumfahrt- und Systemtechnik G.m.b.H., Vienna (Austria).

HERMES: DRINK/FOOD-WATER SUPPLY ASSEMBLY

H. W. MALNIG *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 367-371 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

A recommendation for a Hermes food/drink Water Supply Assembly (WSA) is presented. The main components of the WSA are the chiller which provides cold potable water and the heater for hot water for food preparation. Tradeoffs in combination with the pressurization system result in the following concepts: Chiller: a cylindric batch tank with a concentric cooling coil and swirler yielding an equivalent to free convection, the quantity of in- and out-flowing water is balanced. Heater: two joined externally heated hemispheric shells with an equatorial bladder, which is reciprocating under incoming water inherent pressure, balancing in- and out-flowing water volume. ESA

N89-28265# Österreichische Raumfahrt- und Systemtechnik G.m.b.H., Vienna (Austria).

NUTRITION FOR SHORT-DURATION SPACE MISSIONS

C. DAMMERMANN *In* ESA, Third of the 3rd European Symposium on Space Thermal Control and Life Support Systems p 373-377 Dec 1988

Avail: NTIS HC A99/MF A01, ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The role food/galley management (FGM) and nutrition plays within the context of the Hermes ECLSS is discussed. Human physiological and psychological needs as well as Hermes spacecraft mission requirements are presented. The analysis of possible concepts and the definition of the optimum solution were performed under the following constraints: the size of the spaceplane makes it mass and power critical which places a significant constraint on power consumption and mass of the FGMS. Tests for the practical analysis of temperature and palatability aspects of the proposed food were conducted. ESA

N89-28284# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

ECLS SIMULATION PROGRAM

G. KIRSCHNER *In* ESA, Third European Symposium on Space

Thermal Control and Life Support Systems p 507-511 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

Showing the importance and advantages of an integrated simulation, models for EVA, Hermes and Columbus ECLS systems have to be developed. Using modular program technique the same subroutines for equal functions can be used for the different simulation models. The tasks of the single modules are described and it is shown how existing commercial programs are used for in- and out-put, documentation, and data representation. An example from already programmed modules and an outlook for further program development is given. ESA

N89-28295# Aerospatiale, Cannes La Bocca (France).

DEVELOPMENT OF HEAT EXCHANGERS FOR HYBRID RADIATORS

M. AMIDIEU and T. LAFON (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 515-522 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

A preliminary study yielded two basic concepts for a heat exchanger, namely: one dry contact exchanger in which the fluid circuit and the heat pipes contact each other through their outer shell; one wet contact exchanger, where one of the fluids comes into contact with the other element. From a comparative analysis of the two concepts, taking into account criteria of performance, manufacturing and operational use, the dry contact exchanger was selected for development. ESA

N89-28286# Martin Marietta Aerospace, Denver, CO. Astronautics Group.

DEVELOPMENT OF A NOVEL HIGH-PERFORMANCE CONTACT HEAT EXCHANGER

W. H. MILLER and T. BUNA *In* ESA, Third European Symposium on Space Thermal Control and Life Support Systems p 523-528 Dec. 1988

Avail: NTIS HC A99/MF A01; ESA Publications Div., ESTEC, Noordwijk, Netherlands, 80 Dutch guilders or 45 US dollars

The development of a contact heat exchanger for space station type applications with the objective of providing on-orbit replaceability of damaged or degraded radiators is described. The device is to provide disconnect type thermal coupling between heat pipe radiators and the internal heat transport fluid loops of the thermal management system. The key issue to be resolved was to ensure precise mating between the contact surfaces, determined to be a necessary condition for ensuring the required high conductance. This was achieved by the use of precision manufacturing techniques and the use of a conical contact geometry. Analyses, test approach, and results are presented indicating a highly competitive thermal performance. ESA

N89-28298# Army Research Inst of Environmental Medicine, Natick, MA.

ANALYSIS OF ARTICULATED MANIKIN BASED CONVECTIVE HEAT TRANSFER DURING WALKING

STEPHEN KW. CHANG and RICHARD R. GONZALEZ Mar 1989 43 p

(Contract DA PROJ 3E1-62787-A-878)

(AD-A208299; USARIEM-T-11-89) Avail NTIS HC A03/MF A01 CSCL 06/4

Using the articulated manikin at U.S. Army Research Institute of Environmental Medicine (USARIEM) as a model, the effect of the walking motion on the local convective heat transfer at various body sites was studied. The forced convective heat transfer coefficient (hc) was determined by the naphthalene sublimation technique. The results showed that the arm movement during walking, unexpectedly, diminished the local convective transfer coefficient. Increasing gait actually resulted in a decrease in hc, as measured on the arms and legs. On the non-moving body trunk, no significant difference in hc was observed with changing

gait. When the manikin was held stationary and the chamber wind speed increased, a corresponding increase in hc was observed. Thus, during walking, motion of the swinging limbs, the pendulum effect, tends to decrease the forced convective heat transfer as observed locally on the limbs. GRA

N83-28299# Georgia Inst. of Tech., Atlanta.
**IDENTIFICATION OF VARIABLES DETERMINING
 INTRAHEMISPHERIC INTERFERENCE BETWEEN
 PROCESSING DEMANDS** Final Report, 1981-1985

JOANNE GREEN Apr. 1989 166 p
 (Contract MDA903-81-C-0443)
 (AD-A208435; ARI-RN-89-17) Avail: NTIS HC A08/MF A01
 CSCL 05/8

This research note describes basic research aimed at understanding principles of brain hemisphere functioning which can be used to improve human performance. The research is most relevant for understanding performance based on visual information perceived by peripheral vision, and examines how intrahemispheric interference affects performance degradation when two task-related activities depend on the same hemisphere of the brain. It was found that even in apparently simple tasks, small changes increasing or decreasing the difficulty of cognitive decision making are very powerful in determining how interactions within hemispheres will affect performance. When intrahemispheric interference occurred, changes in response requirements simplifying the decisional processes necessary to organize the response served to reduce interference. Effects of intrahemispheric interference may reduce performance based on stimuli in a particular location, or reduce it by one hand relative to the other. There are individual differences in the magnitude of intrahemispheric interference and its effects degrading performance as well. GRA

N89-28300# Universal Energy Systems, Inc., Dayton, OH.
 Biomedical Applications Research Div.
**ANTHROPOMETRIC MEASUREMENTS OF AVIATORS WITHIN
 THE AVIATION EPIDEMIOLOGY DATA REGISTER** Final
 Report

ROBERT H. SCHRIMSHER and THOMAS J. BURKE Mar. 1989
 46 p
 (Contract DA PHOJ. 3E1-62787-A-878)
 (AD-A208609; USAARL-89-5) Avail: NTIS HC A03/MF A01
 CSCL 06/4

Beginning in 1983, the U.S. Army Aviation Epidemiology Data Register (AEDR) was developed. The AEDR is a permanent, computer-accessible repository of medical information on the Army aviation population. This automated database system provides data for developing and evaluating aviation medical selection and retention standards, for conducting epidemiologic studies on health risk factors, and the natural history of disease in the aviation environment, for evaluating health hazards in the aviation environment, and for providing human factors input to engineers developing aircraft, weapons, and life support equipment. Twenty anthropometric measurements on 22,000 male flight school applicants, 29,000 male aviators, 800 female flight school applicants, and 600 female aviators are recorded in the Aviation Epidemiology Data Register (AEDR). Summary statistics for the anthropometric measurements of these four populations, including mean, standard deviation, and the 1, 5, 50, 95, and 99 percentile values, are reported. These values are reported in a tabular format with the corresponding values from five other Department of Defense anthropometric studies. GRA

N89-28301# Northwestern Univ., Evanston, IL Neuroscience
 Lab

**PERCEPTION OF MOTION IN STATISTICALLY-DEFINED
 DISPLAYS** Final Scientific Report, 1 Oct. 1985 - 30 Sep. 1988

ROBERT SEKULER 15 Apr. 1989 278 p
 (Contract AF-AFOSR-0370-85; AF PROJ. 2313)
 (AD-A208695; AFOSR-89-0769TR) Avail: NTIS HC A13/MF A01
 CSCL 06/5

This project used statistically-complex displays to probe

higher-orders of human motion perception. The project's overall aim was to establish the characteristics of human visual mechanisms that extract information from these and other displays. A fundamental contribution was the systematic refinement and extension of a model in which motion information is extracted and processed, via non-linear interactions, by directionally-selective visual mechanisms. Prior work has shown that a percept of global coherent motion can be produced from the combination of many different, localized motion vectors. Using random-dot cinematograms, we established that hysteresis is strongly associated with such percepts. It was previously found that practice seemed to produce direction-selective improvement in observers' ability to discriminate between highly similar directions of motion. Investigators clarified the basis for this improvement by recording an observers eye movements while they target motion. Investigators also created random-dot cinematograms in which each dot's successive movements were independently drawn from a Gaussian distribution of directions of some characteristic bandwidth. GRA

N89-28302# Rice Univ., Houston, TX. Dept. of Psychology.
**HUMAN COGNITION AND INFORMATION DISPLAY IN C3I
 SYSTEM TASKS** Research Note Oct. 1985 - Nov. 1986

WILLIAM C. HOWELL, DAVID M. LANE, and KRITINA L.
 HOLDEN Dec. 1988 42 p
 (Contract MDA903-85-C-0347)
 (AD-A210012; REPT-86-1; ARI-RN-88-106) Avail: NTIS HC
 A03/MF A01 CSCL 25/5

It is widely recognized that the growing demands of modern warfare strain and in some cases exceed human cognitive capabilities. Although modern command, control, communication, and intelligence (C3I) systems incorporate a number of advanced design concepts to reduce the burden on operators, it is essential that they retain certain key controlling functions. Therefore, efforts toward improving our understanding of how various design concepts affect human (and overall system) performance must continue. In particular, it is not always clear how general design principles relate to the specific kinds of critical tasks performed by operators in C3I systems. The purpose of this report is to present a highly selective review of the literature on C3I tasks, display principles, and human information processing functions with an eye toward identifying promising variables or concepts for evaluation in a simulated system context. GRA

N89-28303# Naval Air Development Center, Warminster, PA.
 Air Vehicle and Crew Systems Technology Dept.

**EVALUATION OF THERMAL STRESS INDUCED BY
 HELICOPTER AIRCREW CHEMICAL, BIOLOGICAL,
 RADIOLOGICAL (CBR) PROTECTIVE ENSEMBLE** Final Report,
 3 Nov. 1987 - 17 Dec. 1988

JONATHAN W. KAUFMAN, KATHERINE Y. DEJNEKA, STEPHEN
 MORRISSEY, and ALVAH BITTNER, JR. 15 Jun. 1988 31 p
 Prepared in cooperation with Analytix, Inc., Willow Grove, PA
 (AD-A210123; NADC-89009-60) Avail: NTIS HC A03/MF A01
 CSCL 15/6

The A/P22P-9(V) Chemical, Biological, Radiological (CBR) Protective Assembly for helicopter aircrews has been evaluated for the additional thermal stress it imparts to users in a hot environment. The standard aircrew life support system for helicopters, based on the CWU-27/P flight coverall, was employed as the experimental control. Two environmental conditions were studied: (1) a simulated hot aircraft interior (hot) with chamber temperatures maintained at dry bulb temperatures 32.5C and a wet bulb temperature 25.0C; and (2) a control environment (cool), with chamber temperatures maintained at 20.9C. Three males, aged 24 to 35 years, were exposed twice to each garment/environment condition combination, for a total of eight exposures each, except for one subject who was studied in cool conditions only once in each of the configurations, for a total of six runs. Heat durations were designed for 480 minutes. Comparison by ensemble show significant differences observed for exposure durations, while rectal temperatures were significantly different (p less than 0.05) between ensembles only in hot conditions. Ambient conditions significantly impacted on nearly all

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measured parameters. The results indicate that the CBR ensemble represents a limiting factor in performance in a hot environment.

GRA

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SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

A89-49173

STABILIZING THE OPTICAL ACTIVITY OF MOLECULES IN A SOLID AT LOW TEMPERATURE [STABILIZATSIIA OPTICHESKOI AKTIVNOSTI MOLEKUL V TVERDYKH TELAKH PRI NIZKOI TEMPERATURE]

IU. A. BERLIN, S. O. GLADKOV, V. I. GOL'DANSKII, and V. V. KUZ'MIN (AN SSSR, Institut Khimicheskoi Fiziki, Moscow, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 306, no. 4, 1989, p. 844-847. In Russian. refs

This paper considers a possibility of stabilizing optical activity in chiral molecules incorporated in a low-temperature solid matrix, through relaxation processes that take into account not only particle tunnelling (nondiagonal transitions) but also diagonal transitions, i.e., transitions inside one of the holes of a double-hole potential. The results of calculations indicate that molecular racemization can be effectively suppressed in the case of low-temperature reactions that take place in the 'dirty-ice' coating on the surface of dust inside interstellar dark gas-dust clouds. I.S.

A89-51501* Katholieke Universiteit, Nijmegen (Netherlands).

LIFE SCIENCES AND SPACE RESEARCH XXIII(2): PLANETARY BIOLOGY AND ORIGINS OF LIFE; PROCEEDINGS OF THE TOPICAL MEETING AND WORKSHOPS XX, XXI AND XXIII OF THE 27TH COSPAR PLENARY MEETING, ESPOO, FINLAND, JULY 18-29, 1988

A. W. SCHWARTZ, ED. (Nijmegen, Katholieke Universiteit, Netherlands), K. DOSE, ED. (Mainz, Universitaet, Federal Republic of Germany), D. M. RAUP, ED. (Chicago, University, IL), H. P. KLEIN, ED. (Santa Clara, University, CA), and D. L. DEVINCENZI, ED. (NASA, Ames Research Center, Moffett Field, CA). Meeting and Workshops sponsored by COSPAR. Advances in Space Research (ISSN 0273-1177), vol. 9, no. 6, 1989, 225 p. For individual items see A89-51502 to A89-51530.

This volume includes chapters on exobiology in space, chemical and early biochemical evolution, life without oxygen, potential for chemical evolution in the early environment of Mars, planetary protection issues and sample return missions, and the modulation of biological evolution by astrophysical phenomena. Papers are presented on the results of spaceflight missions, the action of some factors of space medium on the abiogenic synthesis of nucleotides, early peptidic enzymes, microbiology and biochemistry of the methanogenic archaeobacteria, and present-day biogeochemical activities of anaerobic bacteria and their relevance to future exobiological investigations. Consideration is also given to the development of the Alba Patera volcano on Mars, biological nitrogen fixation under primordial Martian partial pressures of dinitrogen, the planetary protection issues in advance of human exploration of Mars, and the difficulty with astronomical explanations of periodic mass extinctions. I.S.

A89-51502

EXO BIOLOGY - RESULTS OF SPACEFLIGHT MISSIONS

H. D. MENNINGMANN (Frankfurt, Universitaet, Frankfurt am Main, Federal Republic of Germany) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 3-12. refs

This paper describes the types of experiments for exploring

the probabilities for living matter to exist in space, which were designed to investigate the effect of exposure of microorganisms to space, and to collect microorganisms from space. Results of laboratory experiments indicated that, although the inactivation of bare bacterial spores by solar UV rays is, at most, a matter of a few minutes, the low temperature of the space environment and a protective coating by ice drastically reduce the sensitivity of simple molecules. Based on extrapolations of these data to space conditions, it is speculated that spores may survive for hundreds of thousands to millions years, the time sufficient for spores to travel from one solar system to another. These results point to a serious problem in 'planetary quarantine', especially in view of the enormous number of spores deposited from spacecraft into space. I.S.

A89-51503

SYNTHESIS OF ORGANIC COMPOUNDS IN INTERSTELLAR DUST AND THEIR TRANSPORT TO EARTH VIA COMETS

J. MAYO GREENBERG (Leiden, Rijksuniversiteit, Netherlands) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 15-23. refs

Evidence for low-temperature comet aggregation and the chemical evolution of interstellar dust from a presolar system is presented that serves to support the theory that interstellar dust grains in pristine form constitute the basic building blocks of comets, and that a major fraction of comets is in the form of complex organic molecules which are, at least partially, of a prebiotic nature. The low-density (not greater than 0.3 g/cm³) estimated for the comet microstructure further provides a physical basis for the hypothesis that comets bring a significant fraction of the original interstellar organic molecules to the earth, unmodified by the impact event. Evidence now exists that not only amino acids but also pyrimidines constituted a part of the interstellar prebiotic chemical composition of comets brought to the early earth. I.S.

A89-51504

HAVE COMETS PLAYED A ROLE IN THE PRIMARY ORGANIC SYNTHESSES?

A. H. DELSEMME (Toledo, University, OH) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 25-34. refs

Synthesis of more than sixty different organic molecules is presently known to have occurred in interstellar space, including molecules important for prebiotic chemistry, such as HCN, H₂CO, CH₃CN, C₂H₂, and CH₃C₂H. A scenario is proposed that explains the formation of the atmosphere and the oceans of the earth, as well as the transport to earth of the products of primary organic synthesis by comets and carbonaceous chondrites. The scenario includes the condensation of these molecules (with the formation of H₂O and CO₂) on interstellar grains upon a collapse of a molecular cloud to form a star, the heating (more or less, depending on their distance from the star) of the frosty interstellar grains by the central star, the formation of the planets, carbonaceous chondrites, and comets from interstellar grains located, respectively, at the closest, intermediate, and furthest distances from the star. I.S.

A89-51505

PREBIOTIC-LIKE ORGANIC SYNTHESSES IN EXTRATERRESTRIAL ENVIRONMENTS - THE CASE OF TITAN

F. RAULIN, N. DUBOULOZ, and C. FRERE (Paris XII, Universite, Creteil, France) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) Advances in Space Research (ISSN

0273-1177), vol. 9, no. 6, 1989, p. 35-47. refs
(Contract CNES-86-1245; CNES-87-1247)

Data are presented on the atmospheric chemical constituents of Titan, which were detected or inferred from the results of laboratory studies or simulation experiments. It is shown that on Titan, under the very low temperature conditions prevailing on it, chemical evolution is still going on; it takes place in the absence of liquid water, which is likely to be presently covered by an ocean of liquid ethane and methane. Microphysical modeling of these processes shows that, in the low atmosphere of Titan, the aerosols would be constituted of a nucleus (composed mainly of nitriles) of several tens of microns in mean diameter, covered by a thick layer of propane, ethane, and methane. Thermodynamic modeling of the Titan's ocean indicates that it should include high concentrations of various organics. I.S.

A89-51506

MODIFICATION OF SIMPLE ORGANIC SOLIDS IN SPACE - ENERGETIC CARBON INTERACTIONS WITH SOLID METHANE

A. PATNAIK, K. ROESSLER, and E. ZADOR (Kernforschungs-
anlage Juelich GmbH, Federal Republic of Germany)
(COSPAR, Plenary Meeting, 27th, Topical Meeting and
Workshops on the Life Sciences and Space Research XXIII(2);
Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo,
Finland, July 18-29, 1988) *Advances in Space Research* (ISSN
0273-1177), vol. 9, no. 6, 1989, p. 49-52. refs

Results are presented on laboratory experiments simulating
organic synthesis in space, using solid methane as a model
substance for primordial organic solids by high energy carbon atom
reactions combined with radiolysis (or photolysis). High-energy
carbon atom reactions were initiated within solid methane by
nuclear reaction on the C-12 atoms, in the process C-12(He-3,
He-4)C-11 induced by 20-MeV He-3(+2) particles. The results of
gas-chromatographic analysis of the target indicated the formation
of many new carbon compounds ranging from acetylene and
ethylene to molecules containing up to eight carbon atoms. I.S.

A89-51507

THE ACTION OF SOME FACTORS OF SPACE MEDIUM ON THE ABIOTIC SYNTHESIS OF NUCLEOTIDES

E. A. KUZICHEVA, N. V. TSUPKINA, and N. G. POTAPOVA (AN
SSSR, Institut Tsitologii, Leningrad, USSR) (COSPAR, Plenary
Meeting, 27th, Topical Meeting and Workshops on the Life Sciences
and Space Research XXIII(2); Planetary Biology and Origins of
Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988)
Advances in Space Research (ISSN 0273-1177), vol. 9, no. 6,
1989, p. 53-56. refs

Experiments designed to investigate possible states of chemical
evolution under conditions of space environment are described.
Results from studies aboard Salyut-7 indicate that the synthesis
of natural nucleotides can take place abiotically under space
conditions and that high temperature (50 C) favors the formation
of natural nucleotides. I.S.

A89-51508

THE GAMMA-IRRADIATION OF AQUEOUS HYDROGEN CYANIDE IN THE PRESENCE OF FERROCYANIDE OR FERRICYANIDE - IMPLICATIONS TO PREBIOTIC CHEMISTRY

R. NAVARRO-GONZALEZ, C. PONNAMPERUMA (Maryland,
University, College Park), A. NEGRON-MENDOZA, and M. E.
AGUIRRE-CALDERON (Universidad Nacional Autonoma de
Mexico, Coyoacan, Mexico) (COSPAR, Plenary Meeting, 27th,
Topical Meeting and Workshops on the Life Sciences and Space
Research XXIII(2); Planetary Biology and Origins of Life, 20th,
21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in
Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 57-61.
refs

The gamma-irradiation of 0.1 M, O₂-free, aqueous HCN was
studied in the presence of ferrocyanide or ferricyanide in the
concentration range 0.001-0.00001 M, in order to get an insight
into the possible role that cyanocomplexes of iron may have played
in promoting prebiotic syntheses via the free-radical oligomerization

of HCN. It was found that ferrocyanide or ferricyanide have no
effect on the irradiation of 0.1 M HCN solutions at concentrations
equal to or below 0.0001 M. At high concentrations, 0.001 M,
they lead to a marked decrease in the conversion of HCN. There
was no significant difference due to the oxidation state of iron
used, particularly at high doses not lower than 100 kGy. Author

A89-51509

A QUANTITATIVE ASSAY OF BIOLOGICALLY IMPORTANT COMPOUNDS IN SIMULATED PRIMITIVE EARTH EXPERIMENTS

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PONNAMPERUMA (Maryland, University, College Park) (COSPAR,
Plenary Meeting, 27th, Topical Meeting and Workshops on the
Life Sciences and Space Research XXIII(2); Planetary Biology and
Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29,
1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no.
6, 1989, p. 63-66. refs

Results are presented on chemical yields of several products
formed in a CH₄/N₂/H₂C(vapor) gas mixture subjected to a
high-voltage (20 kV) high-frequency (0.3 MHz) electric discharge.
The energy input in the electric discharge was varied from 0.016
to 3.048 MJ/mol. The values of the chemical yields at the lowest
energy input, calculated in terms of a number of molecules formed
or destroyed per 100 eV of energy input were as follows: (-CH₄)
= 6.48; (-N₂) = 2.51; (C₂H₂) = 1.16; (HCN) = 0.215; (CH₃CHO)
= 0.115; (CH₃CH₂CHO) = 0.00161; (CH₂CO₂H)₂ = 0.0000339;
(CH₄ yielding solid material) = 0.196; and (N₂ yielding solid
material) = 0.00355. I.S.

A89-51510* Rensselaer Polytechnic Inst., Troy, NY.

MINERAL CATALYSIS OF THE FORMATION OF THE PHOSPHODIESTER BOND IN AQUEOUS SOLUTION - THE POSSIBLE ROLE OF MONTMORILLONITE CLAYS

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and Workshops on the Life Sciences and Space Research XXIII(2);
Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo,
Finland, July 18-29, 1988) *Advances in Space Research* (ISSN
0273-1177), vol. 9, no. 6, 1989, p. 67-75. refs
(Contract NSF CHE-85-06377; NGR-33-018-148)

The possible role of montmorillonite clays in the spontaneous
formation on the primitive earth of the phosphodiester bond in
the presence of water was investigated in experiments measuring
the binding of various nucleosides and nucleotides with
Na(+)-montmorillonite 22A and the reactions of these compounds
with a water-soluble carbodiimide. It was found that, at neutral
pH, adenine derivatives bind stronger than the corresponding uracil
derivatives, consistent with the protonation of the adenine by the
acidic clay surface and a cationic binding of the protonated ring
to the anionic clay surface. The reaction of the 5-prime-AMP with
carbodiimide resulted in the formation of 2-prime,5-prime-pApA
(18.9 percent), 3-prime,5-prime-pApA (11 percent), and AppA (4.8
percent). The yields of these oligomers obtained when poly(U)
was used in place of the clay were 15.5 percent, 3.7 percent,
and 14.9 percent AppA, respectively. I.S.

A89-51511

NUCLEIC ACID ANALOGUES AND THE ORIGINS OF REPLICATION

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and Workshops on the Life Sciences and Space Research XXIII(2);
Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo,
Finland, July 18-29, 1988) *Advances in Space Research* (ISSN
0273-1177), vol. 9, no. 6, 1989, p. 77-81. refs

In view of the fact that experiments on nonenzymatic
template-directed oligomerization of mononucleotides revealed
serious problems for linking between some of the natural
monomers, a possibility is explored that alternative structures, the
'nucleic acid-like' molecules, may have preceded the natural
polynucleotides in chemical evolution. Arguments are presented

that analogs based on 8-hydroxymethyladenine and 5-hydroxymethyluracil are promising candidates as nucleotide precursors for primitive nucleic acid-like molecules. I.S.

A89-51512

EARLY PEPTIDIC ENZYMES

ANDRE BRACK and BERNARD BAHBIER (CNRS, Centre de Biophysique Moléculaire, Orleans, France) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 83-87. refs

Experimental evidence is presented for selective condensation and selective resistance to degradation of amino acids in water, demonstrating that oligopeptides could have been synthesized on primitive earth from a mixture of organic compounds in liquid water. It is also shown that polypeptides containing lysyl or arginyl and hydrophobic residues are capable of accelerating the hydrolysis of oligoribonucleotides. Well-defined short peptides were synthesized in order to determine the critical chain-length required for chemical activity. It is noted, however, that the synthesis of oligonucleotides under plausible prebiotic conditions is still an unsolved challenge, and early accumulation of oligonucleotides is problematic because of their fragility. I.S.

A89-51517

PRESENT-DAY BIOGEOCHEMICAL ACTIVITIES OF ANAEROBIC BACTERIA AND THEIR RELEVANCE TO FUTURE EXOBIOLOGICAL INVESTIGATIONS

R. S. OREMLAND (USGS, Menlo Park, CA) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 127-136. refs

If the primordial atmosphere was reducing, then the first microbial ecosystem was probably composed of anaerobic bacteria. However, despite the presence of an oxygen-rich atmosphere, anaerobic habitats are important, commonplace components of the earth's present biosphere. The geochemical activities displayed by these anaerobes impact the global cycling of certain elements (e.g., C, N, S, Fe, Mn). Methane provides an obvious example of how human-enhanced activities on a global scale can influence the content of a 'radiative' (i.e., infrared absorbing) trace gas in the atmosphere. Methane can be oxidized by anaerobic bacteria, but this does not appear to support their growth. Acetylene, however, does support such growth. This may form the basis for future exobiological investigations of the atmospheres of anoxic, hydrocarbon-rich planets like Jupiter and Saturn, as well as the latter's satellite Titan. Author

A89-51520* Nevada Univ., Reno.

EARLY MARTIAN ENVIRONMENTS - THE ANTARCTIC AND OTHER TERRESTRIAL ANALOGS

R. A. WHARTON, JR. (Nevada, University, Reno), C. P. MCKAY, R. L. MANCINELLI (NASA, Ames Research Center, Moffett Field, CA), and G. M. SIMMONS, JR. (Virginia Polytechnic Institute and State University, Blacksburg) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 147-153. Research supported by NSF and University of Nevada. refs

The comparability of the early environments of Mars and earth, and the biological evolution which occurred on early earth, motivates serious consideration of the possibility of an early Martian biota. Environments which could have contained this early Martian life and which may presently contain evidence of this former life include aquatic, ice, soil, and rock habitats. Several analogs of these potential early Martian environments, which can provide useful information in searching for extinct life on Mars, are currently available for study on earth. These terrestrial analogs include the

perennially ice-covered lakes and sandstone rocks in the polar deserts of Antarctica, surface of snowfields and glaciers, desert soils, geothermal springs, and deep subsurface environments. Author

A89-51521* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

BIO-MARKERS AND THE SEARCH FOR EXTINCT LIFE ON MARS

D. E. SCHWARTZ and R. L. MANCINELLI (NASA, Ames Research Center, Moffett Field, CA) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 155-158. refs

In order to predict what biomarkers could be used on Mars, several biomarkers, or key signatures, of extinct life on earth are identified. Some of these biomarkers which may be applicable to Mars include reduced carbon and nitrogen compounds, CO₃(2-), SO₄(2-), NO₃(-), Mg, Mn, Fe, and the isotopic ratios of C, N, and S. It is suggested that a fully equipped Mars rover might be able to perform analyses to measure most of these biomarkers while on the Martian surface. I.S.

A89-51522* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

STABLE CARBON ISOTOPE FRACTIONATION IN THE SEARCH FOR LIFE ON EARLY MARS

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The utility of measurements of C-13/C-12 ratios in organic vs inorganic deposits for searching for signs of life on early Mars is considered. It is suggested that three assumptions are necessary. First, if there was life on Mars, it caused the fractionation of carbon isotopes in analogy with past biological activity on earth. Second, the fractionation would be detectable. Third, if a fractionation would be observed, there exist no abiotic explanations for the observed fractionation pattern. I.S.

A89-51523* Florida State Univ., Tallahassee.

LIFE ON MARS - HOW IT DISAPPEARED (IF IT WAS EVER THERE)

E. IMRE FRIEDMANN and ALI M. KORIEM (Florida State University, Tallahassee) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 167-172. refs (Contract NSG-7337, NSF DPP-83-14180)

Information available on Mars chemistry suggest that conditions on early Mars may have been suitable for life. This paper examines the possible events that led to the disappearance of life, assuming it existed, from the surface of Mars. The sequence of events leading to life extinction on early Mars assumes the following steps: (1) a decrease of temperature and humidity levels, leading to a selection of microorganisms for tolerance of low temperatures and arid conditions; (2) further deterioration of environment leading to withdrawal of cold-adapted organisms to protected niches under the surface; (3) further cooling producing heavy stresses in these organisms; and (4) further deterioration of the environment resulting in extinction. This sequence of events is considered parallel events documented for the microbial community in the Ross Desert of Antarctica, where TEM examinations of the material detected progressive stages of cell damage and death. I.S.

A89-51524* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

BIOLOGICAL NITROGEN FIXATION UNDER PRIMORDIAL MARTIAN PARTIAL PRESSURES OF DINITROGEN

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One of the most striking differences between the conditions on early Mars and earth was a low (18 mb) partial pressure of N₂ (pN₂) on early Mars, as opposed to 780 mb N₂ on earth. To investigate the possibility of biological nitrogen fixation under conditions of early Mars, experiments were carried out on the growth of *Azotobacter vinelandii* and *Azomonas agilis* in nitrogen-free synthetic medium under various partial pressures of N₂ (ranging from 780 to 0 mb). It was found that, although the biomass, cell number, and growth rate of these bacteria decreased with decreasing pN₂ values below pN₂ of 400 mb, both microorganisms were capable of growing at pN₂ as low as 5 mb (but not at or below 1 mb), indicating that biological fixation of nitrogen could have occurred on primordial Mars. I.S.

A89-51525* National Aeronautics and Space Administration, Washington, DC.

PLANETARY PROTECTION POLICY OVERVIEW AND APPLICATION TO FUTURE MISSIONS

JOHN D. RUMMEL (NASA, Life Sciences Div., Washington, DC) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 181-184.

The current status of planetary protection (quarantine) policy within NASA is discussed, together with the issues of planetary protection and back-contamination as related to future missions. The policy adopted by COSPAR in 1984 (and recently reaffirmed by the NASA Administrator) for application to all unmanned missions to other solar system bodies and all manned and unmanned sample return missions is examined. Special attention is given to the implementation of the policy and to the specific quarantine-related constraints on spacecraft involved in solar system exploration that depend on the nature of the mission and the identity of the target body. I.S.

A89-51527* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PEROXIDES AND THE SURVIVABILITY OF MICROORGANISMS ON THE SURFACE OF MARS

ROCCO L. MANCINELLI (NASA, Ames Research Center, Moffett Field, CA) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 191-195. refs

This paper discusses the possibility that any terrestrial microorganisms brought to Mars might survive the inhospitable environment of that planet, with special attention given to the effects of highly oxidizing material that is now known to cover the Martian surface. Data obtained by the gas exchange experiment on Viking indicate that, if all of the released oxygen is assumed to come from H₂O₂, the concentrations of H₂O₂ on Mars range from 25 to 250 ppm. Laboratory data indicate that certain soil bacteria are able to survive and grow to stationary phase at H₂O₂ concentrations as high as 30,000, indicating that, if there is H₂O₂ at the level of 250 ppm or even an order of magnitude greater on the Martian surface, this fact alone would not make the surface of Mars self-sterilizing. I.S.

A89-51528* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PLANETARY PROTECTION ISSUES IN ADVANCE OF HUMAN EXPLORATION OF MARS

CHRISTOPHER P. MCKAY (NASA, Ames Research Center, Moffett Field, CA) and WANDA L. DAVIS (Search for Extraterrestrial Intelligence Institute, Los Altos, CA) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 197-202. refs

The major planetary quarantine issues associated with human exploration of Mars, which is viewed as being more likely to harbor indigenous life than is the moon, are discussed. Special attention is given to the environmental impact of human missions to Mars due to contamination and mechanical disturbances of the local environment, the contamination issues associated with the return of humans, and the planetary quarantine strategy for a human base. It is emphasized that, in addition to the question of indigenous life, there may be some concern of returning to earth the earth microorganisms that have spent some time in the Martian environment. It is suggested that, due to the fact that a robot system can be subjected to more stringent controls and protective treatments than a mission involving humans, a robotic sample return mission can help to eliminate many planetary-quarantine concerns about returning samples. I.S.

A89-51529* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PLANETARY PROTECTION ISSUES FOR SAMPLE RETURN MISSIONS

D. L. DEVINCENZI (NASA, Ames Research Center, Moffett Field, CA) and H. P. KLEIN (Santa Clara University, CA) (COSPAR, Plenary Meeting, 27th, Topical Meeting and Workshops on the Life Sciences and Space Research XXIII(2): Planetary Biology and Origins of Life, 20th, 21st, and 23rd, Espoo, Finland, July 18-29, 1988) *Advances in Space Research* (ISSN 0273-1177), vol. 9, no. 6, 1989, p. 203-206.

Planetary protection (PP) issues for both a comet nucleus sample return (CNSR) mission and a Mars rover sample return (MRSR) mission are discussed, with special attention given to the PP requirements for such missions, the exobiology science objectives for the CNSR and MRSR missions, and a qualitative PP risk assessment for both mission types. A set of contamination control procedures for both missions is presented, which identify procedures for each of the mission phases (i.e., the prelaunch, launch, sample handling, transit vehicle, and earth return). Recommendations for further research and technology development are discussed. I.S.

N89-28304*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

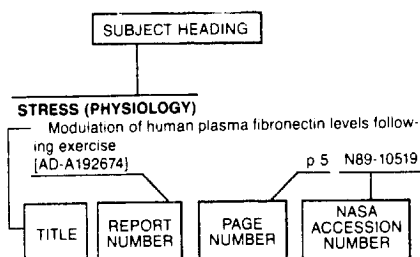
LIFE SCIENCE RESEARCH OBJECTIVES AND REPRESENTATIVE EXPERIMENTS FOR THE SPACE STATION

CATHERINE C. JOHNSON, ed., ROGER D. ARNO, ed., and RICHARD MAINS, ed. (Mains Associates, Moffett Field, CA.) Apr. 1989 299 p
(NASA-TM-89445; A-87160; NAS 1.15:89445) Avail: NTIS HC A13/MF A01 CSCL 06/3

A workshop was convened to develop hypothetical experiments to be used as a baseline for space station designer and equipment specifiers to ensure responsiveness to the users, the life science community. Sixty-five intra- and extramural scientists were asked to describe scientific rationales, science objectives, and give brief representative experiment descriptions compatible with expected space station accommodations, capabilities, and performance envelopes. Experiment descriptions include hypothesis, subject types, approach, equipment requirements, and space station support requirements. The 171 experiments are divided into 14 disciplines.

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Typical Subject Index Listing



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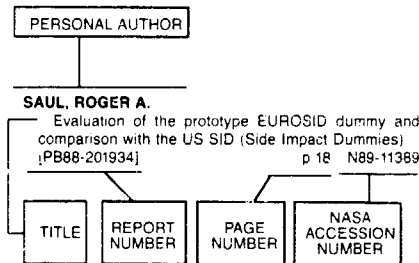
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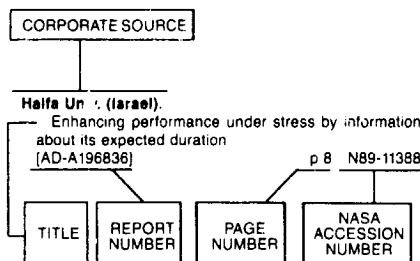
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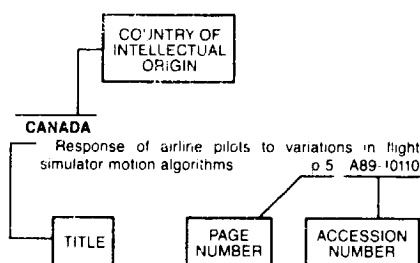
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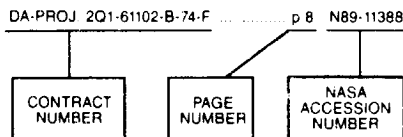
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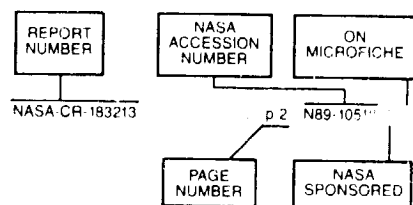
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AEROSPACE MEDICINE AND BIOLOGY / A Continuing Bibliography (Supplement 330)

December 1989

Typical Report Number Index Listing



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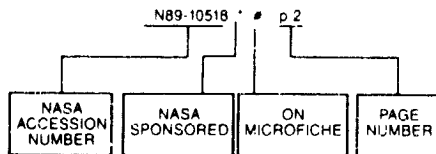
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AEROSPACE MEDICINE AND BIOLOGY / A Continuing Bibliography (Supplement 330)

December 1989

Typical Accession Number Index Listing



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